Operating Instructions

Diesel engine
V 4000 M70
V 4000 M71
Application group 1B

M015412/03E

Power. Passion. Partnership.

Printed in Germany

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This handbook is provided for use by maintenance and operating personnel in order to avoid malfunctions or damage during operation.

Subject to alterations and amendments.

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1 Safety

1.1 General conditions

General

In addition to the instructions in this publication, the applicable country-specific legislation and other compulsory regulations regarding accident prevention and environmental protection must be observed. This state-of-the-art engine has been designed to meet all applicable laws and regulations. The engine may nevertheless present a risk of injury or damage in the following cases:

- Incorrect use
- Operation, maintenance and repair by unqualified personnel
- Modifications or conversions
- Noncompliance with the Safety Instructions

Correct use

The engine is intended solely for use in accordance with contractual agreements and the purpose envisaged for it on delivery. Any other use is considered improper use. The engine manufacturer accepts no liability whatsoever for resultant damage or injury in such case. The responsibility is borne by the user alone.

Correct use also includes observation of and compliance with the maintenance specifications.

Modifications or conversions

Unauthorized modifications to the engine represent a safety risk.

MTU will accept no liability or warranty claims for any damage caused by unauthorized modifications or conversions.

Spare parts

Only genuine MTU spare parts must be used to replace components or assemblies. MTU accepts no liability whatsoever for damage or injury resulting from the use of other spare parts and the warranty shall be voided in such case.

Reworking components

Repair or engine overhaul must be carried out in workshops authorized by MTU.

TIM-ID: 0000000860 - 017

1.2 Personnel and organizational requirements

Personnel requirements

Work on the engine must only be carried out by appropriately qualified and instructed personnel.

Observe the minimum legal age.

Responsibilities of the operating, maintenance and repair personnel must be specified by the operating company.

Organizational measures

This publication must be issued to all personnel involved in operation, maintenance, repair or transportation.

Keep it handy in the vicinity of the engine such that it is accessible to operating, maintenance, repair and transport personnel at all times.

Use the manual as a basis for instructing personnel on engine operation and repair. In particular, personnel must have read and understood the safety-relevant instructions.

This is especially important for personnel who work on the engine only on an occasional basis. These persons shall receive repeated instruction.

Use the Spare Parts Catalog to identify spare parts during maintenance and repair work.

Working clothes and protective equipment

Wear proper protective clothing for all work.

Depending on the kind of work, use the necessary personal protective equipment.

TIM-ID: 0000000874 - 017

1.3 Transport

Transport

Use only the lifting eyes provided to lift the engine.

Only use transport and lifting devices approved by MTU.

Take the engine's center of gravity into account.

Transport the engine in the installation position only, max. permissible diagonal pull 10°.

In the case of special packaging with aluminum foil, suspend the engine by the lifting eyes of the transport pallet or transport with equipment suitable for heavy loads (forklift truck).

Install the crankshaft locking device and the locking screws for the engine mounts prior to engine transportation.

Secure the engine against tilting during transportation. The engine must be additionally secured against slipping or tilting when going up or down inclines and ramps.

Setting down the engine following transportation

Set the engine down on a firm, level surface only.

Make sure that the consistency and load-bearing capacity of the ground or support surface is adequate.

Never set an engine down on the oil pan unless expressively authorized to do so by MTU on a case-to-case basis .

TIM-ID: 0000002622 - 006

1.4 Safety regulations for startup and operation

Safety requirements for initial operation

Prior to initial operation of the unit, install the assembly or unit according to the specifications and check the installation according to the MTU specifications.

Before putting the device or plant into operation, always ensure:
- that all maintenance and repair work is completed,
- that all loose parts have been removed from rotating machine components,
- that nobody is in the danger area of moving machine parts.

Immediately after putting the device or plant into operation, make sure that all control and display instruments as well as the signaling and alarm systems work properly.

Safety requirements for operators

The procedures for cases of emergency must be practiced regularly.

The operator must be familiar with the control and display elements.

The operator must be familiar with the consequences of any operations performed.

During operation, the display instruments and monitoring units must be permanently observed with regard to present operating status, violation of limit values and warning or alarm messages.

The following steps must be taken if a malfunction of the system is recognized or reported by the system:
- inform supervisor(s) in charge,
- analyze the message,
- if required, carry out emergency operations e.g. emergency engine stop.

Engine operation

The following conditions must be fulfilled before starting the engine:
- Wear ear protection.
- Ensure that the engine room is well ventilated.
- Do not inhale engine exhaust gases.
- Ensure that the exhaust system is free of leaks and that the gases are discharged to atmosphere.
- Mop up any leaked or spilt fluids and lubricants immediately or soak up with a suitable binding agent.
- Protect battery terminals, battery-charger terminals and cables against accidental contact.
- When the engine is running, never release coolant, oil, fuel, compressed-air or hydraulic lines.

Operation of electrical equipment

When electrical equipment is in operation, certain components of these appliances are electrically live.

Observe the safety instructions for these devices.

TIM-ID: 0000023743 - 009

1.5 Explosion hazard when removing inspection port cover on engine

DANGER

Explosion hazard due to oil vapors.
Risk of serious injury – danger to life!
- Allow the engine to cool down before opening the crankcase!
- Avoid open flames, electrical sparks and ignition sources.

Safety instructions

▶ Before starting maintenance work, allow the engine to cool down for at least 10 min. (danger of explosion due to oil vapors).

TIM-ID: 0000022931 - 006

1.6 Safety regulations for maintenance and repair work

Safety regulations for maintenance and repair work

Have maintenance and repair work carried out by qualified and authorized personnel only.

Allow the engine to cool down before starting maintenance work (risk of explosion of oil vapors).

Before starting work, relieve pressure in systems and compressed-air lines which are to be opened.

Take special care when removing ventilation or plug screws from the engine. Cover the screw or plug with a rag to prevent fluids escaping under pressure.

Take special care when draining hot fluids ⇒ Risk of injury.

When changing the engine oil or working on the fuel system, ensure that the engine room is adequately ventilated.

Allow the engine / system to cool down before starting to work.

Observe the maintenance and repair instructions.

Never carry out maintenance and repair work with the engine running unless expressly instructed to do so.

Secure the engine against accidental starting.

Disconnect the battery when electrical starters are fitted.

Close the main valve on the compressed-air system and vent the compressed-air line when pneumatic starters are fitted.

Disconnect the control equipment from the assembly or system.

Use only proper, calibrated tools. Observe the specified tightening torques during assembly/disassembly.

Carry out work only on assembles and/or units which are properly secured.

Never use lines for climbing.

Keep fuel injection lines and connections clean.

Always seal connections with caps or covers if a line is removed or opened.

Take care not to damage lines, in particular fuel lines, during maintenance and repair work.

Ensure that all retainers and dampers are installed correctly.

Ensure that all fuel injection and pressurized oil lines are installed with enough clearance to prevent contact with other components. Do not place fuel or oil lines near hot components.

Do not touch elastomeric seals if they have carbonized or resinous appearance unless hands are properly protected.

Note cooling time for components which are heated for installation or removal ⇒ Risk of burning.

When working high on the engine, always use suitable ladders and work platforms. Make sure components are placed on stable surfaces.

Observe special cleanness when conducting maintenance and repair work on the assembly or system. After completion of maintenance and repair work, make sure that no loose objects are in/on the assembly or system.

Before barring the engine, make sure that nobody is standing in the danger zone. Check that all guards have been reinstalled and that all tools and loose parts have been removed after working on the engine.

The following additional instructions apply to starters with beryllium copper pinion:

- Breathing protection of filter class P2 must be applied during maintenance work to avoid health hazards caused by the beryllium-containing pinion. Do not blow out the interior of the flywheel housing or the starter with compressed air. Clean the flywheel housing inside with a class H dust extraction device as an additional measure.

TIM-ID: 0000000879 - 023

Welding work

Never carry out welding work on the assembly, system, or engine-mounted units. Cover the engine when welding in its vicinity.

Do not use the assembly or system as ground terminal.

Do not route the welding lead over or near the wiring harnesses of MTU systems. The welding current may otherwise induce an interference voltage in the wiring harnesses which could conceivably damage the electrical system.

Remove parts (e.g. exhaust pipes) which are to be welded from the engine beforehand.

Hydraulic installation and removal

Check the function and safe operating condition of tools and fixtures to be used. Use only the specified devices for hydraulic removal/installation procedures.

Observe the max. permissible push-on pressure specified for the equipment.

Do not attempt to bend or apply force to lines.

Before starting work, pay attention to the following:
- Vent the hydraulic installation/removal tool, the pumps and the lines at the relevant points for the equipment to be used (e.g. open vent plugs, pump until bubble-free air emerges, close vent plugs).
- For hydraulic installation, screw on the tool with the piston retracted.
- For hydraulic removal, screw on the tool with the piston extended.

For a hydraulic installation/removal tool with central expansion pressure supply, screw spindle into shaft end until correct sealing is established.

During hydraulic installation and removal, ensure that nobody is standing in the immediate vicinity of the component to be installed/removed.

Working on electrical/electronic assemblies

Always obtain the permission of the person in charge before commencing maintenance and repair work or switching off any part of the electronic system required to do so.

De-energize the appropriate areas prior to working on assemblies.

Do not damage cabling during removal work. When reinstalling ensure that wiring is not damaged during operation by contact with sharp objects, by rubbing against other components or by a hot surface.

Do not secure cables on lines carrying fluids.

Do not use cable binders to secure cables.

Always use connector pliers to tighten connectors.

Subject the device or system to a function check on completion of all repair work.

Store spare parts properly prior to replacement, i.e. protect them against moisture in particular. Pack defective electronic components and assemblies in a suitable manner when dispatched for repair, i.e. particularly protected against moisture and impact and wrapped in antistatic foil if necessary.

Working with laser equipment

When working with laser equipment, always wear special laser-protection goggles ⇒ Heavily focused radiation.

Laser equipment must be fitted with the protective devices necessary for safe operation according to type and application.

TIM-ID: 0000000879 - 023

For conducting light-beam procedures and measurement work, only the following laser devices must be used:

- Laser devices of classes 1, 2 or 3A.
- Laser devices of class 3B, which have maximum output in the visible wavelength range (400 to 700 nm), a maximum output of 5 mW, and in which the beam axis and surface are designed to prevent any risk to the eyes.

TIM-ID: 0000000879 - 023

1.7 Auxiliary materials, fire prevention and environmental protection

Fire prevention

Rectify any fuel or oil leaks immediately; even splashes of oil or fuel on hot components can cause fires - therefore always keep the engine in a clean condition. Do not leave cloths soaked with fluids and lubricants lying around on the engine. Do not store combustible fluids near the engine.

Do not weld pipes and components carrying oil or fuel. Before welding, clean with a non-combustible fluid.

When starting the engine with a foreign power source, connect the ground lead last and remove it first. To avoid sparks in the vicinity of the battery, connect the ground lead from the foreign power source to the ground lead of the engine or to the ground terminal of the starter.

Always keep suitable fire-fighting equipment (fire extinguishers) at hand and familiarize yourself with their use.

SOLAS classification

On engines/plants with SOLAS classification, operational checks must include the following tasks:
- Check all covers (fitted in accordance with SOLAS requirements) on lube oil and fuel pipe connections (>1.8 bar) for damage, replace as necessary. (→ Page 19)

Noise

Noise can lead to an increased risk of accident if acoustic signals, warning shouts or noises indicating danger are drowned.

At all workplaces with a sound pressure level over 85 dB(A), always wear ear protectors (protective wadding, plugs or capsules).

Environmental protection

Modification or removal of mechanical or electronic components or the installation of additional components as well as the execution of calibration processes that might affect the emission characteristics of the engine are prohibited by emission regulations. Emission control units/systems may only be maintained, exchanged or repaired if the components used for this purpose are approved by MTU or equivalent components. Noncompliance with these guidelines might represent a violation of the Clean Air Act and could involve the termination of the operating license by the emission authorities. MTU does not accept any liability for violations of the emission regulations. MTU will provide assistance and advice if emission-relevant components are intended to be modified. The MTU Maintenance Schedules ensure the reliability and performance of MTU engines and must be complied with over the entire life cycle of the engine.

Only fuels of the specified quality required to achieve emission limits must be used.

In Germany, the VAwS (=regulations governing the use of plants that may affect water quality) is applicable, which means work must only be carried out by authorized specialist companies (MTU is an authorized specialist company).

Dispose of used fluids, lubricants and filters in accordance with local regulations.

Auxiliary materials

Use only fluids and lubricants that have been tested and approved by MTU.

Fluids and lubricants must be kept in suitable, properly designated containers. When using fluids, lubricants and other chemical substances, follow the safety instructions applicable to the product. Take care when handling hot, chilled or caustic materials. When using inflammable materials, avoid sparks and do not smoke.

TIM-ID: 0000002828 - 004

Lead

- When working with lead or lead-containing pastes, avoid direct contact with the skin and do not inhale lead vapors.
- Adopt suitable measures to avoid the formation of lead dust!
- Switch on fume extraction system.
- After coming into contact with lead or lead-containing materials, wash hands!

Acids and alkaline solutions

- When working with acids and alkalis, wear protective goggles or face mask, gloves and protective clothing.
- Immediately remove clothing wetted by acids and alkalis!
- Rinse injuries with plenty of water!
- Rinse eyes immediately with eyedrops or clean tap water.

Painting

- When painting in other than spray booths equipped with extractors, ensure good ventilation. Make sure that adjacent work areas are not affected.
- No naked flames!
- No smoking.
- Observe fire prevention regulations!
- It is absolutely necessary to wear masks providing protection against paint and solvent fumes.

Liquid nitrogen

- Store liquid nitrogen only in small quantities and always in regulation containers without fixed covers.
- Do not bring liquid nitrogen in contact with the body (eyes, hands), as this causes frostbite and numbing.
- Wear protective clothing, gloves, closed shoes and protective goggles!
- Ensure the room is well ventilated. 88% contamination of breathing air with nitrogen will result in suffocation.
- Avoid all knocks and jars to the containers, fixtures or workpieces.

Compressed air

Compressed air is air compressed at excess pressure and is stored in tanks from which it can be extracted.

The pressure at which the air is kept can be read off at pressure gauges which must be connected to the compressed air tanks and the compressed air lines.

When working with compressed air, safety precautions must be constantly observed:

- Pay special attention to the pressure level in the compressed air network and pressure vessel!
- Connecting devices and equipment must either be designed for this pressure or, if the permitted pressure for the connecting elements is lower than the pressure required, a pressure reducing valve and safety valve (set to permitted pressure) must form an intermediate connection. Hose coupling and connections must be securely attached!
- Always wear protective goggles when blowing off tools or extracting chips!
- The snout of the air nozzle is provided with a protective disc (e.g. rubber disc), which prevents airborne particles being reflected and thereby prevents injury to eyes.
- First shut off compressed air lines before compressed air equipment is disconnected from the supply line or before equipment or tool is to be replaced!
- Unauthorized use of compressed air, e.g. forcing flammable liquids (danger class AI, AII and B) out of containers, results in a risk of explosion!
- Forcing compressed air into thin-walled containers (e.g. sheet metal, plastic, glass) for drying purposes or to check for leaks will result in a risk of bursting!
- Do not blow dirty clothing with compressed air when being worn on the body.

TIM-ID: 0000002828 - 004

Used oil

Used oil may contain health-threatening combustion residues.

Rub barrier cream into hands! Wash hands after contact with used oil.

TIM-ID: 000000828 - 004

1.8 Conventions for safety instructions in the text

DANGER	In the event of immediate danger. **Consequences: Death or serious injury** • Remedial action
WARNING	In the event of potentially dangerous situations. **Consequences: Death or serious injury** • Remedial action
CAUTION	In the event of dangerous situations. **Consequences: Minor injury or material damage** • Remedial action
NOTICE	In the event of a situation involving potentially adverse effects on the product. **Consequences: Material damage.** • Remedial action • Additional product information

Note: This manual contains highlighted safety warnings in accordance with the US ANSI Z535 standard which begin with one of the signal words listed above depending on the severity of the hazard.

Safety instructions

1. Read and familiarize yourself with all safety notices before starting up or repairing the product.
2. Pass on all safety instructions to your operating, maintenance, repair and transport personnel.

TIM-ID: 0000000881 - 017

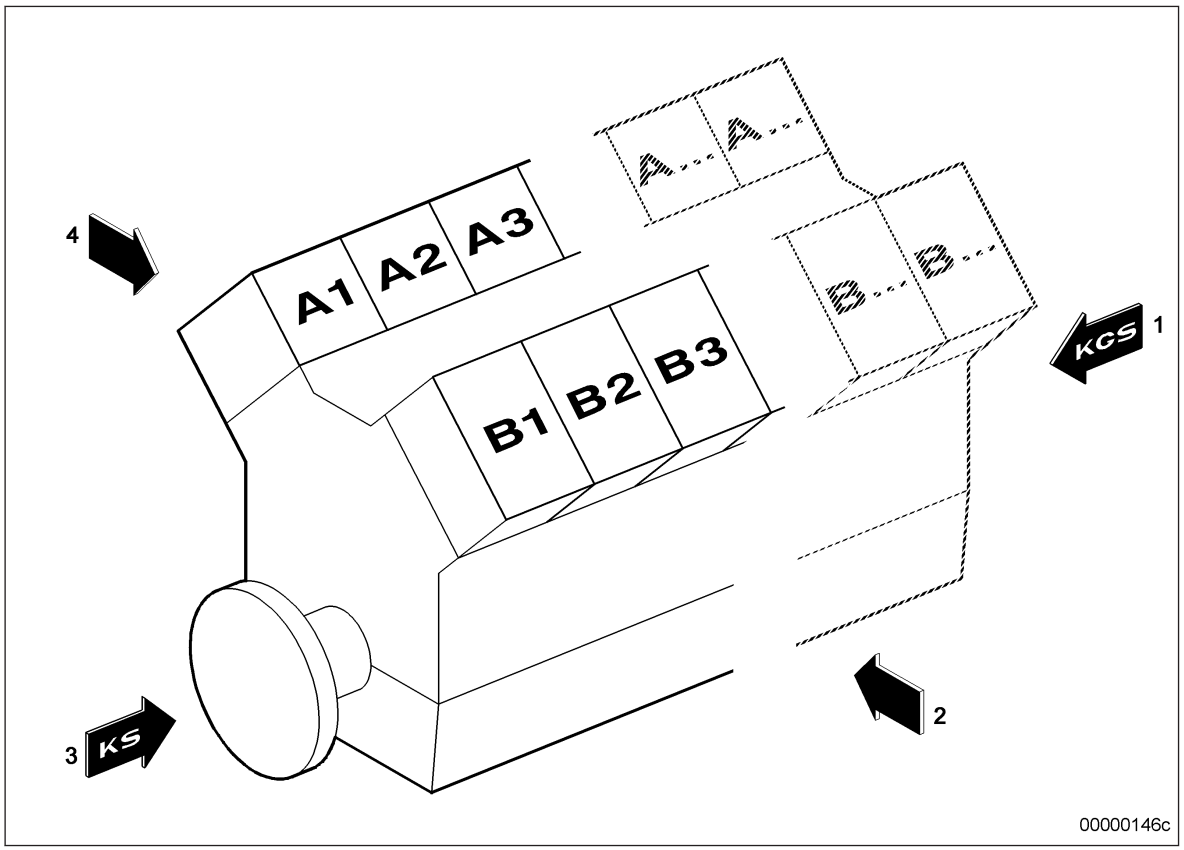
2 General Information

2.1 Engine side and cylinder designations

Engine sides are always designated as viewed from the driving end (KS).

The cylinders of the left engine side are designated "A" and those of the right side "B" (as per DIN ISO 1204). The cylinders of each bank are numbered consecutively, starting with No. 1 at the driving end of the engine.

Other components are numbered in the same way, i.e. starting with No. 1 on driving end.



1 KGS = Free end
2 Right engine side
3 KS = Driving end
4 Left engine side

TIM-ID: 0000000863 - 017

2.2 Product description

Description of the engine

Engine

The engine is a liquid-cooled four-stroke diesel engine, rotating counterclockwise (seen from driving end), with direct injection, sequential turbocharging and charge air cooling.

The engine is monitored by an engine control and monitoring system (MDEC).

Monitoring in the engine room is carried out by the local operating panel (LOP).

Fuel system

Electronically controlled common rail injection system with high-pressure pump, pressure accumulator (rail) and single injectors.

The electronic control unit controls
- Injection start
- Injection quantity
- Injection pressure

Exhaust system

The exhaust system is equipped with triple-walled, water-cooled exhaust lines.

The triple-walled design permits
- low surface temperature,
- reduced amount of heat to be dissipated by the coolant,
- absolute gas-tightness.

Turbocharging

Sequential turbocharging with internal, engine-coolant-controlled charge-air cooling. The right-hand exhaust turbocharger is cut in and cut out with electronically controlled, hydraulically actuated flaps.

Cooling system

Engine cooling as split-circuit cooling system with plate-core heat exchanger.

Heating of the charge air in idle and low-load operation prevents white smoke formation.

Seawater only circulates in the engine coolant cooler and seawater pump.

Service block

The service components are mounted at the auxiliary PTO end.

The layout permits easy access for maintenance.

Service components:
- Raw water pump, coolant pump
- Fuel duplex filter, switchable
- Lube oil multiple filter, switchable
- Centrifugal lube oil filter
- Coolant expansion tank

Electronic system

Electronic control and monitoring system with integrated security and test system with interfaces to remote control system (RCS) and to remote control system (MCS).

TIM-ID: 0000002179 - 002

Electronic engine control unit (ECU)

Functions:
- Engine speed control with fuel and speed limitation dependent on engine status and operating conditions;
- Control of sequential turbocharging;
- Data processing logistics for analog and binary signals;
- Interface for data transfer to CAN field bus for remote control and ship-side monitoring;
- RS 232 interface for connection of MTU dialog unit.

Electronic Engine Monitoring Unit (EMU), optional

Functions:
- Data processing logistics for analog and binary signals;
- Interface for data transfer to CAN field bus for remote control and ship-side monitoring;

Electronic Gear Control Unit (GCU), ship-side wall mounting

Functions:
- Data processing logistics for gear coupling control;
- Input/output signals as well as data transfer to CAN field bus for remote control and ship-side monitoring.

Monitoring in engine room

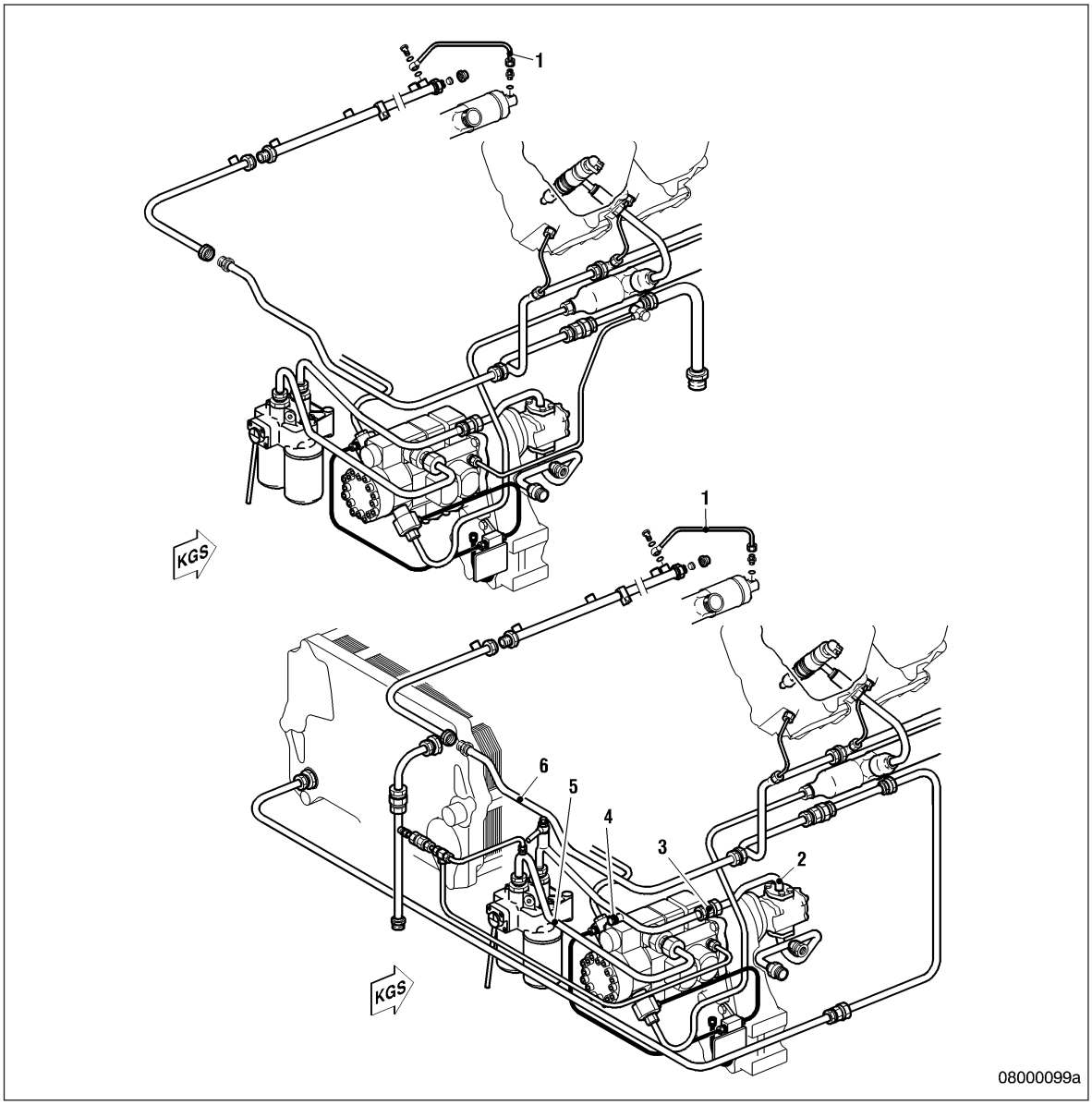
Local operating panel (LOP)

Functions:
- Alphanumeric, monochrome LCD display for monitoring of measured values as well as alarms when limits are violated;
- Pushbuttons for menu control and dimming unit;
- Combined control and display elements for local engine/gear control;
- Flashing light and horn for combined alarm in engine room;
- Interface to CAN field bus for connected, communicating monitoring system components.

TIM-ID: 0000002179 - 002

SOLAS – Fire protection specifications

Fuel system, fuel lines with fuel pressure >1.8 bar

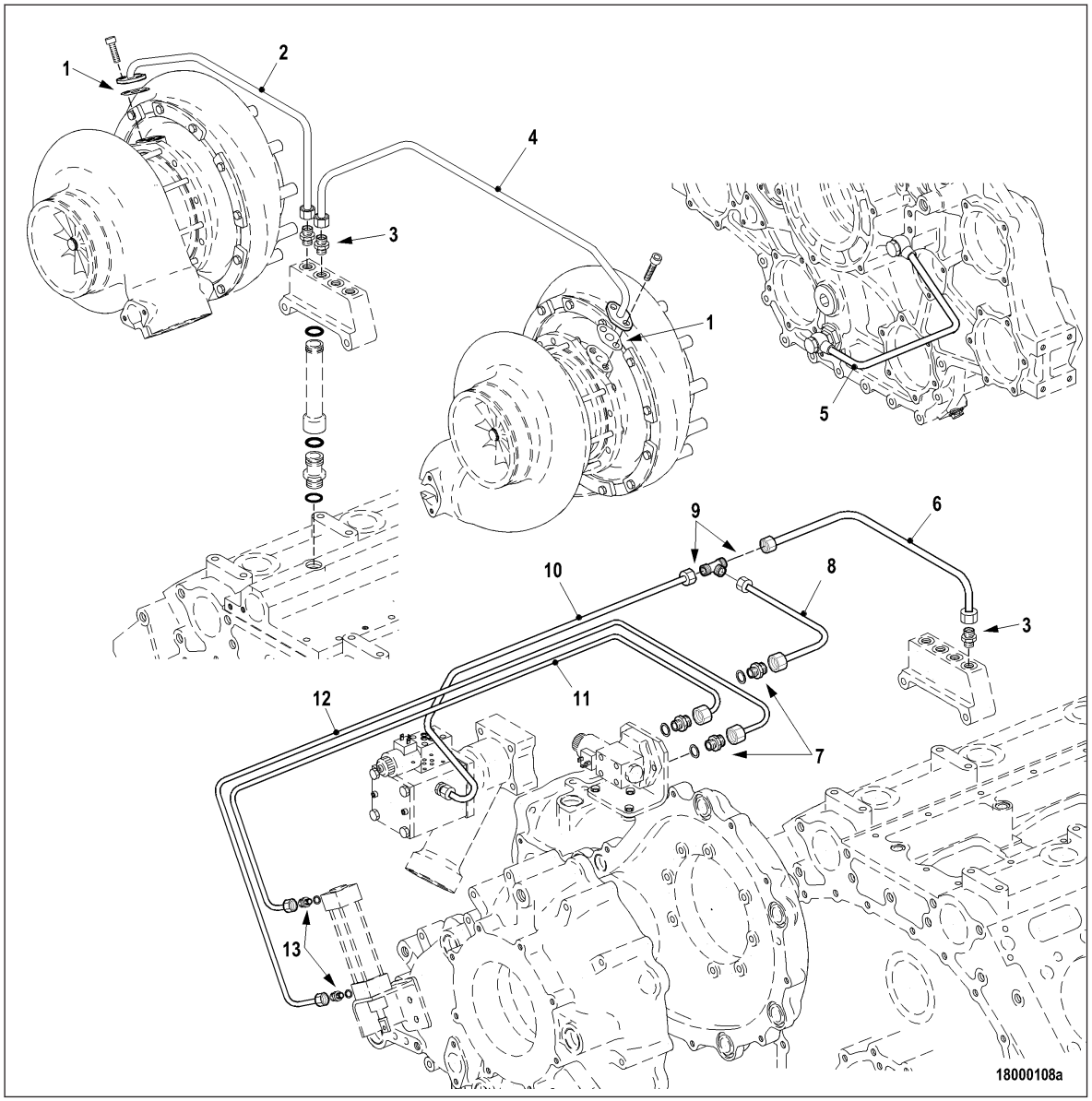


1 Return line
2 Fuel line on fuel delivery pump
3 Check valve
4 Sealing cone
5 Fuel line on HP fuel pump
6 Fuel line on vent line

All lines with SOLAS-compliant covers for pipe connections, according to MTU standard MTN5233, are shown.

TIM-ID: 0000002179 - 002

Lube oil system, oil lines with oil pressure >1.8 bar

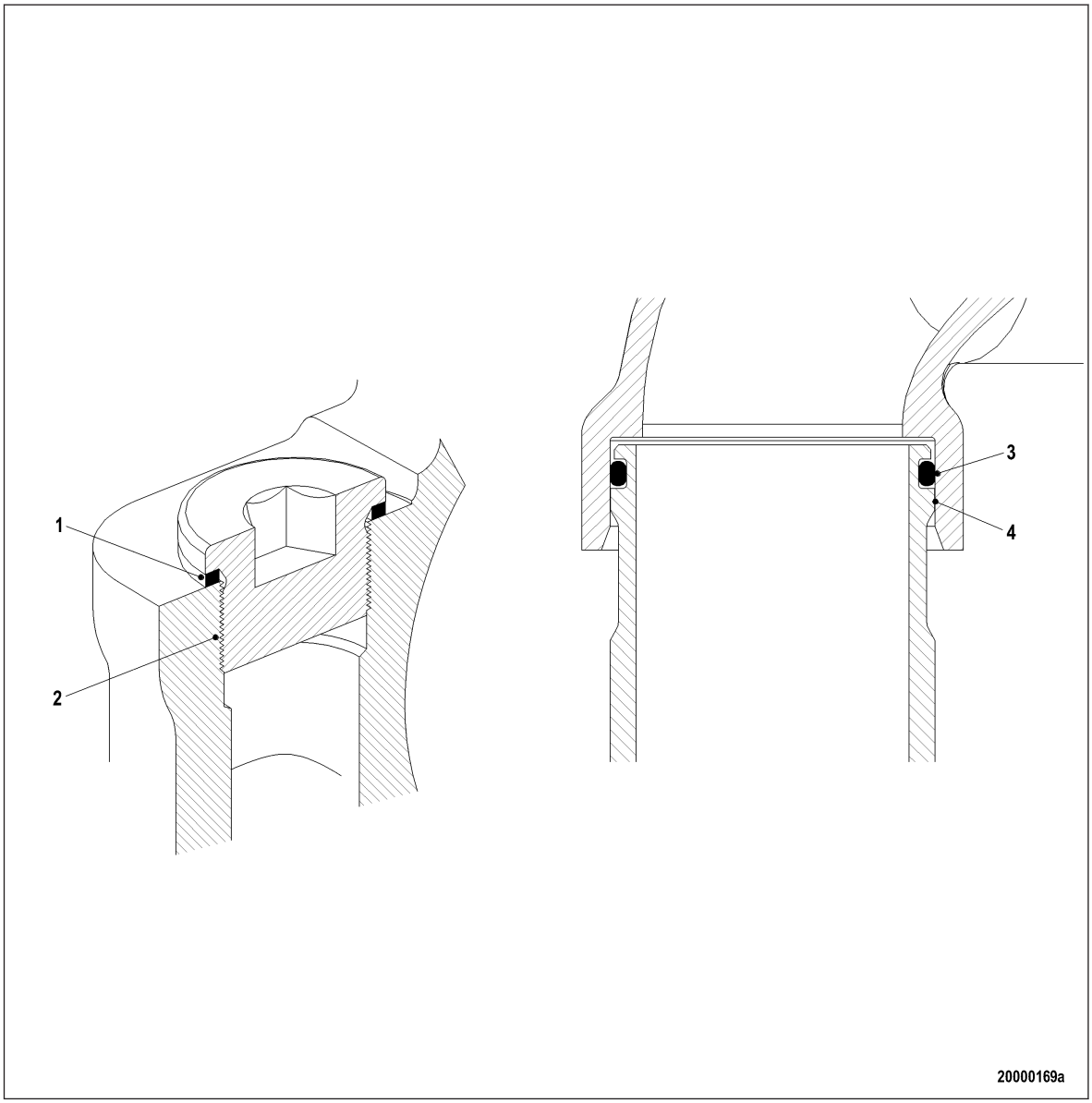


1 Seal, oil line to ETC
2 Oil line, ETC
3 Connection, oil line to distributor
4 Oil line, ETC
5 Oil line, lube oil pump
6 Oil line on distributor
7 Connection, oil line on control block
8 Oil line on control block
9 Oil lines on T-piece
10 Oil line, valve housing
11 Oil line, actuating cylinder to control block
12 Oil line, actuating cylinder to control block
13 Connection, oil line to actuating cylinder

All lines with SOLAS-compliant covers for pipe connections, according to MTU standard MTN5233, are shown.

TIM-ID: 0000002179 - 002

Special connections



In case of leakage, the following connection types are spray-protected even without a cover and have been confirmed compliant with SOLAS by GL and DNV.

Plug-in pipe connection

The sleeve (4) covers the joint to prevent lateral spray.

Only leak-off along the line is possible, the pressure is decreased significantly if an O-ring (3) defect occurs.

The connection is confirmed as compliant with SOLAS by DNV and GL.

Plugs and sensors

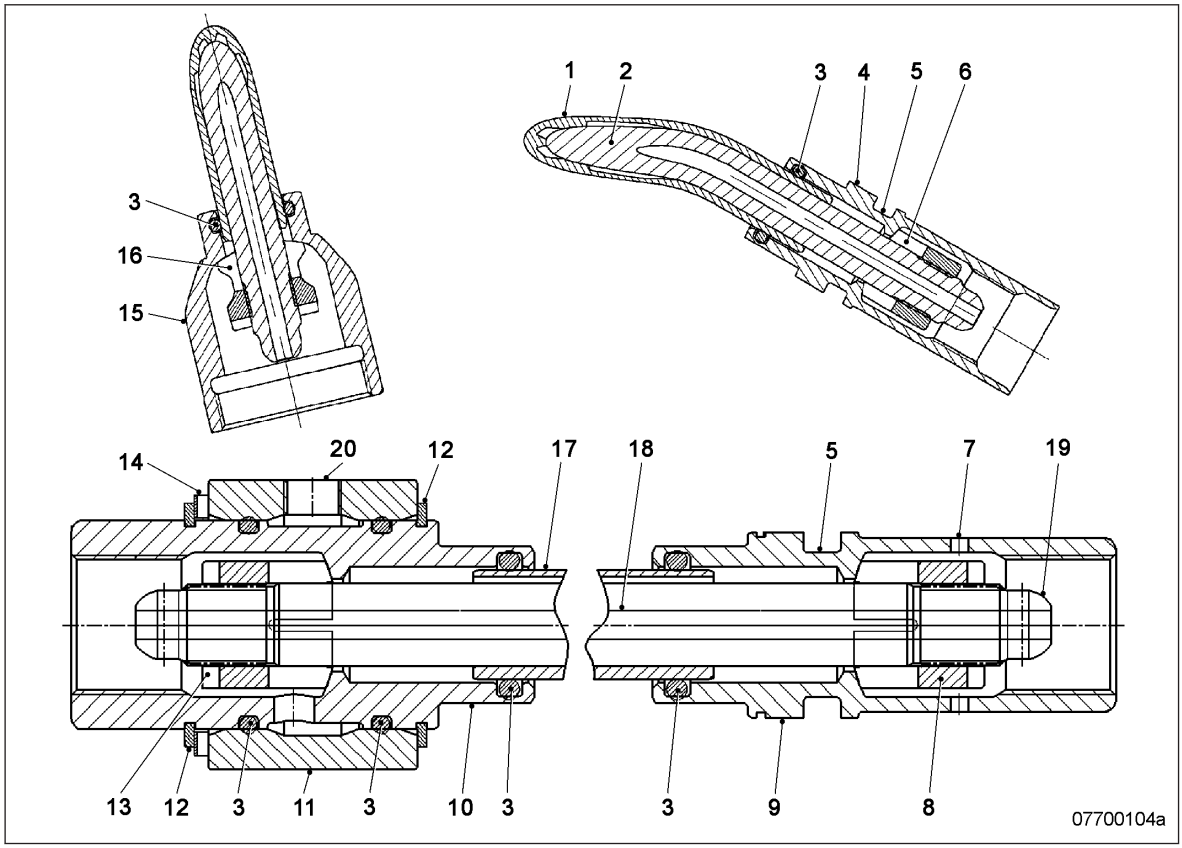
Screw-in plugs (2) are sealed toward the outside either with a copper sealing ring (1), according to DIN, or an O-ring (ISO).

In case of a loose thread or a defective sealing ring (2), the fluid first has to pass the thread.

The pressure is so greatly reduced by this and the faulty sealing ring (2) that any leakage is not under pressure.

TIM-ID: 0000002179 - 002

HP connections



1 Jacket pipe
2 HP line
3 O-ring
4 Union nut
5 Recess for O-ring
6 Thrust ring
7 Leakage overflow bore
8 Thrust ring
9 Union nut
10 Union nut
11 Connecting piece
12 Snap ring
13 Thrust ring
14 Compensating washers
15 Union nut
16 Thrust ring
17 External pipe of HP line
18 Internal pipe of HP line
19 Ball-type seal area
20 Leak fuel connection

The HP fuel line is sealed by the thrust ring (8).

If leakage in the area of the thrust ring (8) or the HP line (5) occurs, the emerging fuel is routed to the leakage chamber.

The leak fuel is drained off without pressure via the leakage overflow bore (7). The leakage chamber is sealed toward the outside by the O-rings (3).

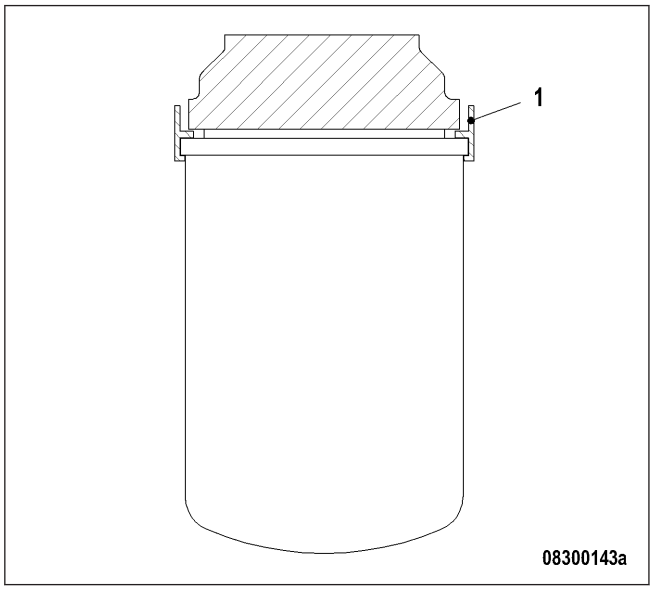
This prevents leaking fuel from escaping.

The connection is confirmed as compliant with SOLAS by DNV and GL.

TIM-ID: 0000002179 - 002

Shielding of fuel filter and lube oil filter

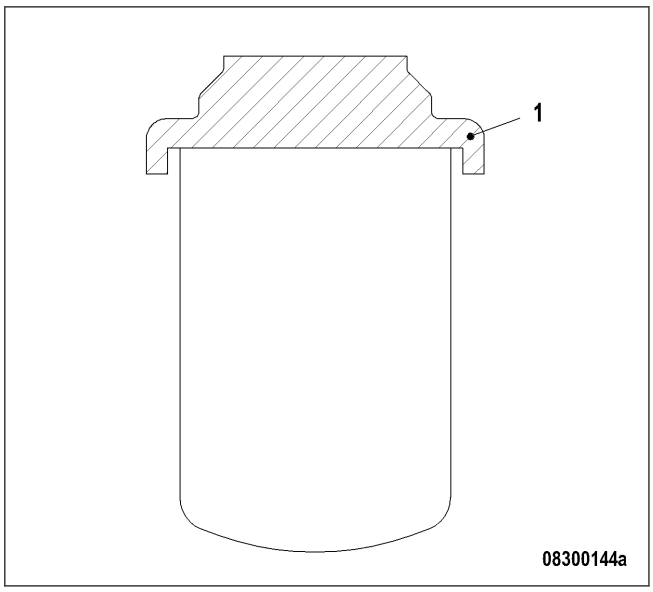
Shielding with a plastic ring



The plastic ring (1) precludes lateral spray.

The fluid is diverted to the catch basin whereby the pressure is significantly reduced.

Shielding by overhang design

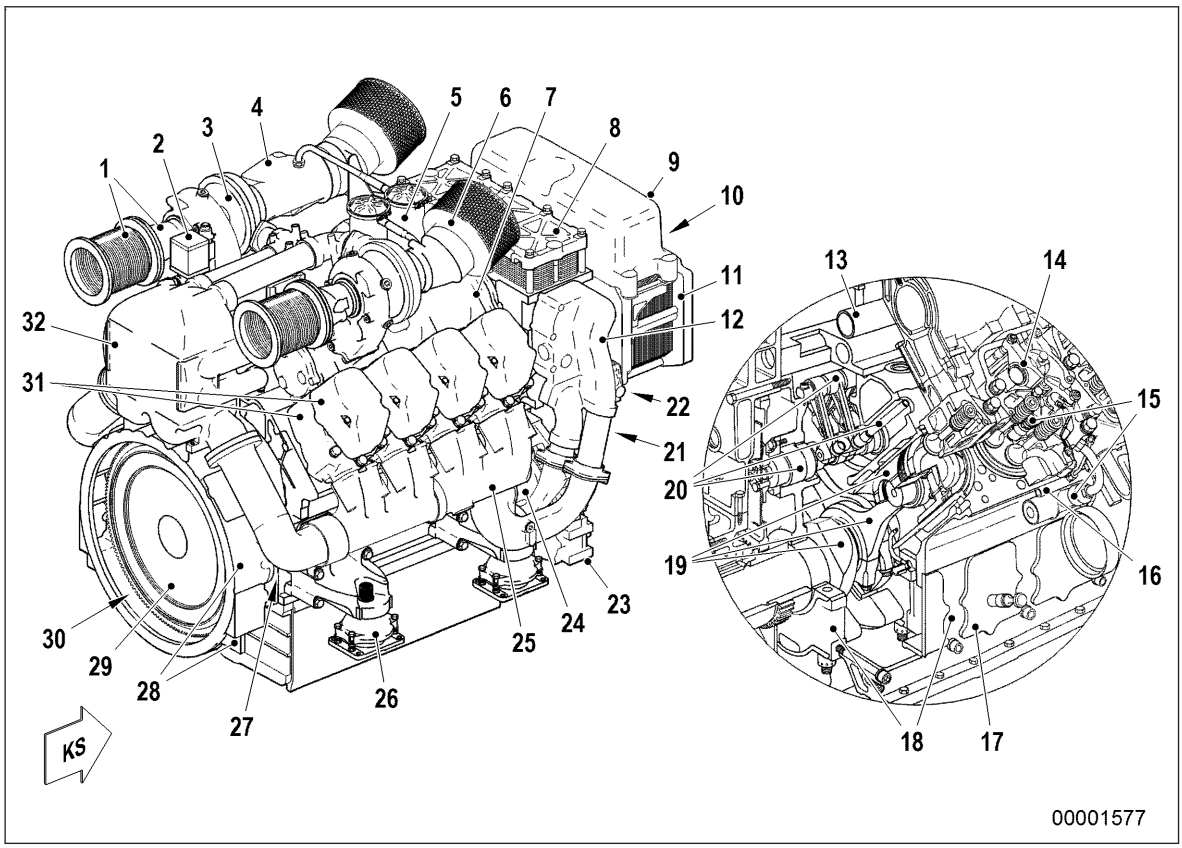


The overhang (1) prevents lateral spray.

The fluid is diverted to the catch basin whereby the pressure is significantly reduced.

TIM-ID: 0000002179 - 002

2.3 Engine – Overview



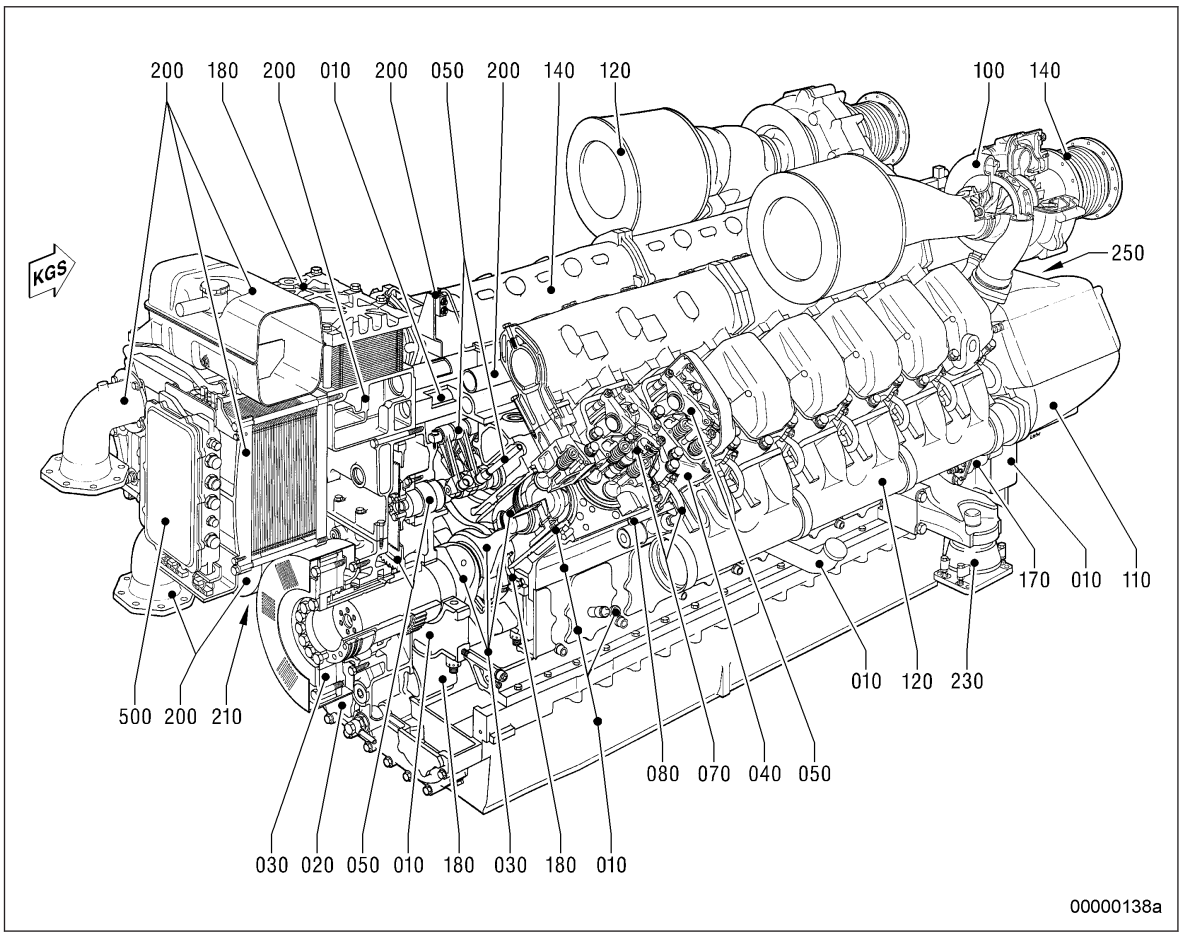
1 Exhaust pipework
2 Air recirculation valve
3 Exhaust turbocharger
4 Air intake/air supply
5 Oil separator
6 Intake elbow
7 Exhaust pipework
8 Oil heat exchanger
9 Coolant expansion tank
10 Engine governor
11 Seawater cooler
12 Thermostat housing
13 Coolant line
14 Valve gear
15 Fuel system (high pressure)
16 Fuel system (low pressure)
17 Inspection port cover
18 Crankcase
19 Running gear
20 Valve gear
21 Electric power supply, engine-related*
22 Drive systems, driving end and free end (coupling)*
23 Equipment carrier
24 Engine coolant pump
25 Charge-air line
26 Mounting/support
27 Starting equipment
28 Flywheel housing
29 Running gear
30 Drive systems, driving end and free end (coupling)*
31 Cylinder head
32 Intercooler
33 Auxiliary systems / accessory equipment*
* not shown

Engine model designation

Key to the engine model designation 8 4000 Mxyz	
8	Number of cylinders
V	Cylinder arrangement: V engine
4000	Series
M	Application
x	Application segment (4, 5, 6, 7, 9)
y	Design index (0,1, 2,...)
z	Additional features

TIM-ID: 0000002083 - 003

2.4 Engine – Overview



010 Crankcase and add-on components
020 Gear train
030 Running gear
040 Cylinder head
050 Valve gear
070 Fuel system (high pressure)
080 Fuel system (low pressure)
100 Exhaust turbocharger
110 Intercooler
120 Air intake/air supply
140 Exhaust pipework
170 Starting equipment
180 Lube oil system/lube oil circuit
200 Coolant system
210 Power supply
230 Mounting/support
250 PTO systems, driving end and free end
360 Auxiliary systems and additional equipment (not illustrated)
500 Monitoring and control system, general electric devices

Applies in the same way also to 12 V 4000 M

Engine model designation

Key to the engine model designation 16V 4000 Mxyz	
16	Number of cylinders
V	Cylinder arrangement: V engine
4000	Series
M	Application
x	Application segment (6, 7, 9)

TIM-ID: 0000036245 - 001

Key to the engine model designation 16V 4000 Mxyz	
y	Design index (0, 1)
z	R (reduced power / speed) L (enhanced power / speed)

TIM-ID: 0000036245 - 001

3 Technical Data

3.1 8V 4000 M70 engine data: IMO, separate heat exchanger, copper-based alloy intercooler

Explanation:

DL Ref. value: Continuous power
BL Ref. value: Fuel stop power
A Design value
G Guaranteed value
R Guideline value
L Limit value, up to which the engine can be operated without changes (e.g. of power setting)
N Not yet defined value
- Not applicable
X Applicable

REFERENCE CONDITIONS

Engine model			8V 4000 M70
Application group			1B
Intake air temperature		°C	25
Raw water inlet temperature		°C	25
Barometric pressure		mbar	1000
Site altitude above sea level		m	100

POWER-RELATED DATA (power ratings are net brake power to ISO 3046)

Number of cylinders			8
Engine rated speed	A	rpm	2000
Fuel stop power ISO 3046	A	kW	1160

GENERAL CONDITIONS (for maximum power)

Number of cylinders			8
Intake air depression (new filter)	A	mbar	25
Intake air depression, max.	L	mbar	35

MODEL-RELATED DATA (basic design)

Number of cylinders			8
Cylinder configuration: V angle		degree	90
Bore		mm	165
Stroke		mm	190
Cylinder displacement		liter	4.06
Total displacement		liter	32.5

TIM-ID: 0000011012 - 001

Number of cylinders			8
Number of inlet valves per cylinder			2
Number of exhaust valves per cylinder			2

LUBE OIL SYSTEM

Number of cylinders			8
Lube-oil operating temperature before engine, from	R	°C	85
Lube oil temperature before engine, to	R	°C	90
Lube oil operating pressure before engine, from	R	bar	5.5
Lube oil operating pressure before engine, to	R	bar	6.0
Lube oil operating pressure (low idle) (meas. point: before engine)	R	bar	2.0

FUEL SYSTEM

Number of cylinders			8
Fuel pressure at engine supply connection, min. (when engine is starting)	L	bar	-0.1
Fuel pressure at supply connection to engine (when engine is running), min.	L	bar	-0.3
Fuel pressure at engine supply connection, max. (when engine is starting)	L	bar	1.5
Fuel supply flow, max.	R	liter/min	15.5

GENERAL OPERATING DATA

Number of cylinders			8
Firing speed, from	R	rpm	80
Firing speed, to	R	rpm	120

STARTING (electric)

Number of cylinders			8
Starter, rated voltage (standard design)	R	V=	24

STARTING (with pneumatic / hydraulic starter)

Number of cylinders			8
Starting air pressure before starter motor, min.	R	bar	16
Starting air pressure before starter motor, max.	R	bar	30

INCLINATIONS, STANDARD OIL SYSTEM (reference: waterline)

Number of cylinders			8
Longitudinal inclination, continuous max. driving end down (Option: max. operating inclinations)	L	degree	15
Longitudinal inclination, temporary max. driving end down (Option: max. operating inclinations)	L	degree	22.5
Longitudinal inclination, continuous max. driving end up (Option: max. operating inclinations)	L	degree	10
Transverse inclination, continuous max. (Option: max. operating inclinations)	L	degree	22.5

TIM-ID: 0000011012 - 001

CAPACITIES

Number of cylinders			8
Engine oil at initial filling (standard oil system) (Option: max. operating inclinations)	R	liter	145
Oil change quantity, max. (standard oil system) (Option: max. operating inclinations)	R	liter	120
Oil pan capacity, dipstick mark min. (standard oil system) (Option: max. operating inclinations)	L	liter	110
Oil pan capacity, dipstick mark max. (standard oil system) (Option: max. operating inclinations)	L	liter	140

WEIGHTS / MAIN DIMENSIONS

Number of cylinders			8
Engine dry weight (with attached standard accessories, without coupling)	R	kg	4470

ACOUSTICS

Number of cylinders			8
Exhaust noise, unsilenced, BL, (free-field sound-pressure level Lp, 1m distance, ISO 6798)	R	db(A)	110
Engine surface noise with attenuated intake noise (filter) - BL (free-field sound pressure level Lp, 1m distance, ISO 6798)	R	db(A)	109

TIM-ID: 0000011012 - 001

3.2 8V 4000 M70 engine data: engine-mounted heat exchanger, IMO

Explanation:

DL Ref. value: Continuous power
BL Ref. value: Fuel stop power
A Design value
G Guaranteed value
R Guideline value
L Limit value, up to which the engine can be operated without changes (e.g. of power setting)
N Not yet defined value
- Not applicable
X Applicable

REFERENCE CONDITIONS

Engine model			8V 4000 M70
Application group			1B
Intake air temperature		°C	25
Raw water inlet temperature		°C	25
Barometric pressure		mbar	1000
Site altitude above sea level		m	100

POWER-RELATED DATA (power ratings are net brake power to ISO 3046)

Number of cylinders			8
Engine rated speed	A	rpm	2000
Fuel stop power ISO 3046	A	kW	1160

GENERAL CONDITIONS (for maximum power)

Number of cylinders			8
Intake air depression (new filter)	A	mbar	25
Intake air depression, max.	L	mbar	35

MODEL-RELATED DATA (basic design)

Number of cylinders			8
Cylinder configuration: V angle		degree	90
Bore		mm	165
Stroke		mm	190
Cylinder displacement		liter	4.06
Total displacement		liter	32.5
Number of inlet valves per cylinder			2
Number of exhaust valves per cylinder			2

TIM-ID: 0000011017 - 001

RAW-WATER CIRCUIT (open circuit)

Number of cylinders			8
Raw water pump: Inlet pressure, min.	L	bar	-0.2
Raw water pump: Inlet pressure , max.	L	bar	0.5
Pressure loss in the external raw-water system, max.	L	bar	2.2

LUBE OIL SYSTEM

Number of cylinders			8
Lube-oil operating temperature before engine, from	R	°C	85
Lube oil temperature before engine, to	R	°C	90
Lube oil operating pressure before engine, from	R	bar	5.5
Lube oil operating pressure before engine, to	R	bar	6.0
Lube oil operating pressure (low idle) (meas. point: before engine)	R	bar	2.0

FUEL SYSTEM

Number of cylinders			8
Fuel pressure at engine supply connection, min. (when engine is starting)	L	bar	-0.1
Fuel pressure at supply connection to engine (when engine is running), min.	L	bar	-0.3
Fuel pressure at engine supply connection, max. (when engine is starting)	L	bar	1.5
Fuel supply flow, max.	R	liter/min	15.5

GENERAL OPERATING DATA

Number of cylinders			8
Firing speed, from	R	rpm	80
Firing speed, to	R	rpm	120

STARTING (electric)

Number of cylinders			8
Starter, rated voltage (standard design)	R	V=	24

STARTING (with pneumatic / hydraulic starter)

Number of cylinders			8
Starting air pressure before starter motor, min.	R	bar	16
Starting air pressure before starter motor, max.	R	bar	30

TIM-ID: 0000011017 - 001

INCLINATIONS, STANDARD OIL SYSTEM (reference: waterline)

Number of cylinders			8
Longitudinal inclination, continuous max. driving end down (Option: max. operating inclinations)	L	degree	15
Longitudinal inclination, temporary max. driving end down (Option: max. operating inclinations)	L	degree	22.5
Longitudinal inclination, continuous max. driving end up (Option: max. operating inclinations)	L	degree	10
Transverse inclination, continuous max. (Option: max. operating inclinations)	L	degree	22.5
Transverse inclination, temporary max. (Option: max. operating inclinations)	L	degree	

CAPACITIES

Number of cylinders			8
Engine coolant, engine-side (with cooler)	R	liter	210
Engine oil at initial filling (standard oil system) (Option: max. operating inclinations)	R	liter	145
Oil change quantity, max. (standard oil system) (Option: max. operating inclinations)	R	liter	120
Oil pan capacity, dipstick mark min. (standard oil system) (Option: max. operating inclinations)	L	liter	110
Oil pan capacity, dipstick mark max. (standard oil system) (Option: max. operating inclinations)	L	liter	140

WEIGHTS / MAIN DIMENSIONS

Number of cylinders			8
Engine dry weight (with attached standard accessories, without coupling)	R	kg	4670

ACOUSTICS

Number of cylinders			8
Exhaust noise, unsilenced, BL, (free-field sound-pressure level Lp, 1m distance, ISO 6798)	R	db(A)	110
Engine surface noise with attenuated intake noise (filter) - BL (free-field sound pressure level Lp, 1m distance, ISO 6798)	R	db(A)	109

TIM-ID: 0000011017 - 001

3.3 12V 4000 M70 engine data: IMO -20%, separate heat exchanger, copper-based alloy intercooler

Explanation:

DL Ref. value: Continuous power
BL Ref. value: Fuel stop power
A Design value
G Guaranteed value
R Guideline value
L Limit value, up to which the engine can be operated without changes (e.g. of power setting)
N Not yet defined value
- Not applicable
X Applicable

REFERENCE CONDITIONS

Engine model			12V 4000 M70
Application group			1B
Intake air temperature		°C	25
Raw water inlet temperature		°C	25
Barometric pressure		mbar	1000
Site altitude above sea level		m	100

POWER-RELATED DATA (power ratings are net brake power to ISO 3046)

Number of cylinders			12
Engine rated speed	A	rpm	2000
Fuel stop power ISO 3046	A	kW	1740

GENERAL CONDITIONS (for maximum power)

Number of cylinders			12
Intake air depression (new filter)	A	mbar	25
Intake air depression, max.	L	mbar	35

MODEL-RELATED DATA (basic design)

Number of cylinders			12
Cylinder configuration: V angle		degree	90
Bore		mm	165
Stroke		mm	190
Cylinder displacement		liter	4.06
Total displacement		liter	48.7
Number of inlet valves per cylinder			2
Number of exhaust valves per cylinder			2

TIM-ID: 0000003038 - 001

LUBE OIL SYSTEM

Number of cylinders			12
Lube-oil operating temperature before engine, from	R	°C	85
Lube oil temperature before engine, to	R	°C	90
Lube oil operating pressure before engine, from	R	bar	5.5
Lube oil operating pressure before engine, to	R	bar	6.0
Lube oil operating pressure (low idle) (meas. point: before engine)	R	bar	2.0

FUEL SYSTEM

Number of cylinders			12
Fuel pressure at engine supply connection, min. (when engine is starting)	L	bar	-0.1
Fuel pressure at supply connection to engine (when engine is running), min.	L	bar	-0.3
Fuel pressure at engine supply connection, max. (when engine is starting)	L	bar	1.5
Fuel supply flow, max.	R	liter/min	20.0

GENERAL OPERATING DATA

Number of cylinders			12
Firing speed, from	R	rpm	80
Firing speed, to	R	rpm	120

STARTING (electric)

Number of cylinders			12
Starter, rated voltage (standard design)	R	V=	24

STARTING (with pneumatic / hydraulic starter)

Number of cylinders			12
Starting air pressure before starter motor, min.	R	bar	17
Starting air pressure before starter motor, max.	R	bar	30

INCLINATIONS, STANDARD OIL SYSTEM (reference: waterline)

Number of cylinders			12
Longitudinal inclination, continuous max. driving end down (Option: max. operating inclinations)	L	degree	15
Longitudinal inclination, temporary max. driving end down (Option: max. operating inclinations)	L	degree	22.5
Longitudinal inclination, continuous max. driving end up (Option: max. operating inclinations)	L	degree	10
Transverse inclination, continuous max. (Option: max. operating inclinations)	L	degree	22.5

TIM-ID: 0000003038 - 001

CAPACITIES

Number of cylinders			12
Engine oil at initial filling (standard oil system) (Option: max. operating inclinations)	R	liter	265
Oil change quantity, max. (standard oil system) (Option: max. operating inclinations)	R	liter	215
Oil pan capacity, dipstick mark min. (standard oil system) (Option: max. operating inclinations)	L	liter	160
Oil pan capacity, dipstick mark max. (standard oil system) (Option: max. operating inclinations)	L	liter	200

WEIGHTS / MAIN DIMENSIONS

Number of cylinders			12
Engine dry weight (with attached standard accessories, without coupling)	R	kg	6600

ACOUSTICS

Number of cylinders			12
Exhaust noise, unsilenced, BL, (free-field sound-pressure level Lp, 1m distance, ISO 6798)	R	db(A)	111
Engine surface noise with attenuated intake noise (filter) - BL (free-field sound pressure level Lp, 1m distance, ISO 6798)	R	db(A)	105

TIM-ID: 0000003038 - 001

3.4 12V 4000 M70 engine data: IMO -20%, engine-mounted heat exchanger, copper-based alloy intercooler

Explanation:

DL Ref. value: Continuous power
BL Ref. value: Fuel stop power
A Design value
G Guaranteed value
R Guideline value
L Limit value, up to which the engine can be operated without changes (e.g. of power setting)
N Not yet defined value
- Not applicable
X Applicable

REFERENCE CONDITIONS

Engine model			12V 4000 M70
Application group			1B
Intake air temperature		°C	25
Raw water inlet temperature		°C	25
Barometric pressure		mbar	1000
Site altitude above sea level		m	100

POWER-RELATED DATA (power ratings are net brake power to ISO 3046)

Number of cylinders			12
Engine rated speed	A	rpm	2000
Fuel stop power ISO 3046	A	kW	1740

GENERAL CONDITIONS (for maximum power)

Number of cylinders			12
Intake air depression (new filter)	A	mbar	25
Intake air depression, max.	L	mbar	35

MODEL-RELATED DATA (basic design)

Number of cylinders			12
Cylinder configuration: V angle		degree	90
Bore		mm	165
Stroke		mm	190
Cylinder displacement		liter	4.06
Total displacement		liter	48.7
Number of inlet valves per cylinder			2
Number of exhaust valves per cylinder			2

TIM-ID: 0000003046 - 001

RAW-WATER CIRCUIT (open circuit)

Number of cylinders			12
Raw water pump: Inlet pressure, min.	L	bar	-0.2
Raw water pump: Inlet pressure , max.	L	bar	+0.5
Pressure loss in the external raw-water system, max.	L	bar	1.5

LUBE OIL SYSTEM

Number of cylinders			12
Lube-oil operating temperature before engine, from	R	°C	85
Lube oil temperature before engine, to	R	°C	90
Lube oil operating pressure before engine, from	R	bar	5.5
Lube oil operating pressure before engine, to	R	bar	6.0
Lube oil operating pressure (low idle) (meas. point: before engine)	R	bar	2.0

FUEL SYSTEM

Number of cylinders			12
Fuel pressure at engine supply connection, min. (when engine is starting)	L	bar	-0.1
Fuel pressure at supply connection to engine (when engine is running), min.	L	bar	-0.3
Fuel pressure at engine supply connection, max. (when engine is starting)	L	bar	1.5
Fuel supply flow, max.	R	liter/min	20.0

GENERAL OPERATING DATA

Number of cylinders			12
Firing speed, from	R	rpm	80
Firing speed, to	R	rpm	120

STARTING (electric)

Number of cylinders			12
Starter, rated voltage (standard design)	R	V=	24

STARTING (with pneumatic / hydraulic starter)

Number of cylinders			12
Starting air pressure before starter motor, min.	R	bar	17
Starting air pressure before starter motor, max.	R	bar	30

TIM-ID: 0000003046 - 001

INCLINATIONS, STANDARD OIL SYSTEM (reference: waterline)

Number of cylinders			12
Longitudinal inclination, continuous max. driving end down (Option: max. operating inclinations)	L	degree	15
Longitudinal inclination, temporary max. driving end down (Option: max. operating inclinations)	L	degree	22.5
Longitudinal inclination, continuous max. driving end up (Option: max. operating inclinations)	L	degree	10
Transverse inclination, continuous max. (Option: max. operating inclinations)	L	degree	22.5

CAPACITIES

Number of cylinders			12
Engine coolant, engine-side (with cooler)	R	liter	250
Engine oil at initial filling (standard oil system) (Option: max. operating inclinations)	R	liter	265
Oil change quantity, max. (standard oil system) (Option: max. operating inclinations)	R	liter	215
Oil pan capacity, dipstick mark min. (standard oil system) (Option: max. operating inclinations)	L	liter	160
Oil pan capacity, dipstick mark max. (standard oil system) (Option: max. operating inclinations)	L	liter	200

WEIGHTS / MAIN DIMENSIONS

Number of cylinders			12
Engine dry weight (with attached standard accessories, without coupling)	R	kg	6800

ACOUSTICS

Number of cylinders			12
Exhaust noise, unsilenced, BL, (free-field sound-pressure level Lp, 1m distance, ISO 6798)	R	db(A)	111
Engine surface noise with attenuated intake noise (filter) - BL (free-field sound pressure level Lp, 1m distance, ISO 6798)	R	db(A)	105

TIM-ID: 0000003046 - 001

3.5 12V 4000 M70 engine data: engine-mounted heat exchanger, EPA stage 2

Explanation:

DL Ref. value: Continuous power
BL Ref. value: Fuel stop power
A Design value
G Guaranteed value
R Guideline value
L Limit value, up to which the engine can be operated without changes (e.g. of power setting)
N Not yet defined value
- Not applicable
X Applicable

REFERENCE CONDITIONS

Engine model			12V 4000 M70
Application group			1B
Intake air temperature		°C	25
Raw water inlet temperature		°C	25
Barometric pressure		mbar	1000
Site altitude above sea level		m	100

POWER-RELATED DATA (power ratings are net brake power to ISO 3046)

Number of cylinders			12
Engine rated speed	A	rpm	2000
Fuel stop power ISO 3046	A	kW	1680

GENERAL CONDITIONS (for maximum power)

Number of cylinders			12
Intake air depression (new filter)	A	mbar	25
Intake air depression, max.	L	mbar	35

MODEL-RELATED DATA (basic design)

Number of cylinders			12
Cylinder configuration: V angle		degree	90
Bore		mm	165
Stroke		mm	190
Cylinder displacement		liter	4.06
Total displacement		liter	48.7
Number of inlet valves per cylinder			2
Number of exhaust valves per cylinder			2

TIM-ID: 0000011021 - 001

RAW-WATER CIRCUIT (open circuit)

Number of cylinders			12
Raw water pump: Inlet pressure, min.	L	bar	-0.2
Raw water pump: Inlet pressure , max.	L	bar	0.5
Pressure loss in the external raw-water system, max.	L	bar	1.5

LUBE OIL SYSTEM

Number of cylinders			12
Lube-oil operating temperature before engine, from	R	°C	85
Lube oil temperature before engine, to	R	°C	90
Lube oil operating pressure before engine, from	R	bar	5.5
Lube oil operating pressure before engine, to	R	bar	6.0
Lube oil operating pressure (low idle) (meas. point: before engine)	R	bar	2.0

FUEL SYSTEM

Number of cylinders			12
Fuel pressure at engine supply connection, min. (when engine is starting)	L	bar	-0.1
Fuel pressure at supply connection to engine (when engine is running), min.	L	bar	-0.3
Fuel pressure at engine supply connection, max. (when engine is starting)	L	bar	1.5
Fuel supply flow, max.	R	liter/min	19.5

GENERAL OPERATING DATA

Number of cylinders			12
Firing speed, from	R	rpm	80
Firing speed, to	R	rpm	120

STARTING (electric)

Number of cylinders			12
Starter, rated voltage (standard design)	R	V=	24

STARTING (with pneumatic / hydraulic starter)

Number of cylinders			12
Starting air pressure before starter motor, min.	R	bar	17
Starting air pressure before starter motor, max.	R	bar	30

TIM-ID: 0000011021 - 001

INCLINATIONS, STANDARD OIL SYSTEM (reference: waterline)

Number of cylinders			12
Longitudinal inclination, continuous max. driving end down (Option: max. operating inclinations)	L	degree	15
Longitudinal inclination, temporary max. driving end down (Option: max. operating inclinations)	L	degree	22.5
Longitudinal inclination, continuous max. driving end up (Option: max. operating inclinations)	L	degree	10
Transverse inclination, continuous max. (Option: max. operating inclinations)	L	degree	22.5

CAPACITIES

Number of cylinders			12
Engine coolant, engine-side (with cooler)	R	liter	250
Engine oil at initial filling (standard oil system) (Option: max. operating inclinations)	R	liter	265
Oil change quantity, max. (standard oil system) (Option: max. operating inclinations)	R	liter	215
Oil pan capacity, dipstick mark min. (standard oil system) (Option: max. operating inclinations)	L	liter	160
Oil pan capacity, dipstick mark max. (standard oil system) (Option: max. operating inclinations)	L	liter	200

WEIGHTS / MAIN DIMENSIONS

Number of cylinders			12
Engine dry weight (with attached standard accessories, without coupling)	R	kg	6660

ACOUSTICS

Number of cylinders			12
Exhaust noise, unsilenced, BL, (free-field sound-pressure level Lp, 1m distance, ISO 6798)	R	db(A)	110
Engine surface noise with attenuated intake noise (filter) - BL (free-field sound pressure level Lp, 1m distance, ISO 6798)	R	db(A)	106

TIM-ID: 0000011021 - 001

3.6 12V 4000 M70 engine data: separate heat exchanger, EPA stage 2

Explanation:

DL Ref. value: Continuous power
BL Ref. value: Fuel stop power
A Design value
G Guaranteed value
R Guideline value
L Limit value, up to which the engine can be operated without changes (e.g. of power setting)
N Not yet defined value
- Not applicable
X Applicable

REFERENCE CONDITIONS

Engine model			12V 4000 M70
Application group			1B
Intake air temperature		°C	25
Raw water inlet temperature		°C	25
Barometric pressure		mbar	1000
Site altitude above sea level		m	100

POWER-RELATED DATA (power ratings are net brake power to ISO 3046)

Number of cylinders			12
Engine rated speed	A	rpm	2000
Fuel stop power ISO 3046	A	kW	1680

GENERAL CONDITIONS (for maximum power)

Number of cylinders			12
Intake air depression (new filter)	A	mbar	25
Intake air depression, max.	L	mbar	35

MODEL-RELATED DATA (basic design)

Number of cylinders			12
Cylinder configuration: V angle		degree	90
Bore		mm	165
Stroke		mm	190
Cylinder displacement		liter	4.06
Total displacement		liter	48.7
Number of inlet valves per cylinder			2
Number of exhaust valves per cylinder			2

TIM-ID: 0000011026 - 001

LUBE OIL SYSTEM

Number of cylinders			12
Lube-oil operating temperature before engine, from	R	°C	85
Lube oil temperature before engine, to	R	°C	90
Lube oil operating pressure before engine, from	R	bar	5.5
Lube oil operating pressure before engine, to	R	bar	6.0
Lube oil operating pressure (low idle) (meas. point: before engine)	R	bar	2.0

FUEL SYSTEM

Number of cylinders			12
Fuel pressure at engine supply connection, min. (when engine is starting)	L	bar	-0.1
Fuel pressure at supply connection to engine (when engine is running), min.	L	bar	-0.3
Fuel pressure at engine supply connection, max. (when engine is starting)	L	bar	1.5
Fuel supply flow, max.	R	liter/min	19.5

GENERAL OPERATING DATA

Number of cylinders			12
Firing speed, from	R	rpm	80
Firing speed, to	R	rpm	120

STARTING (electric)

Number of cylinders			12
Starter, rated voltage (standard design)	R	V=	24

STARTING (with pneumatic / hydraulic starter)

Number of cylinders			12
Starting air pressure before starter motor, min.	R	bar	17
Starting air pressure before starter motor, max.	R	bar	30

INCLINATIONS, STANDARD OIL SYSTEM (reference: waterline)

Number of cylinders			12
Longitudinal inclination, continuous max. driving end down (Option: max. operating inclinations)	L	degree	15
Longitudinal inclination, temporary max. driving end down (Option: max. operating inclinations)	L	degree	22.5
Longitudinal inclination, continuous max. driving end up (Option: max. operating inclinations)	L	degree	10
Transverse inclination, continuous max. (Option: max. operating inclinations)	L	degree	22.5

TIM-ID: 0000011026 - 001

CAPACITIES

Number of cylinders			12
Engine oil at initial filling (standard oil system) (Option: max. operating inclinations)	R	liter	265
Oil change quantity, max. (standard oil system) (Option: max. operating inclinations)	R	liter	215
Oil pan capacity, dipstick mark min. (standard oil system) (Option: max. operating inclinations)	L	liter	160
Oil pan capacity, dipstick mark max. (standard oil system) (Option: max. operating inclinations)	L	liter	200

WEIGHTS / MAIN DIMENSIONS

Number of cylinders			12
Engine dry weight (with attached standard accessories, without coupling)	R	kg	6460

ACOUSTICS

Number of cylinders			12
Exhaust noise, unsilenced, BL, (free-field sound-pressure level Lp, 1m distance, ISO 6798)	R	db(A)	110
Engine surface noise with attenuated intake noise (filter) - BL (free-field sound pressure level Lp, 1m distance, ISO 6798)	R	db(A)	106

TIM-ID: 0000011026 - 001

3.7 16V 4000 M70 engine data: IMO, separate heat exchanger, copper-based alloy intercooler

Explanation:

DL Ref. value: Continuous power
BL Ref. value: Fuel stop power
A Design value
G Guaranteed value
R Guideline value
L Limit value, up to which the engine can be operated without changes (e.g. of power setting)
N Not yet defined value
- Not applicable
X Applicable

REFERENCE CONDITIONS

Engine model			16V 4000 M70
Application group			1B
Intake air temperature		°C	25
Raw water inlet temperature		°C	25
Barometric pressure		mbar	1000
Site altitude above sea level		m	100

POWER-RELATED DATA (power ratings are net brake power to ISO 3046)

Number of cylinders			16
Engine rated speed	A	rpm	2000
Fuel stop power ISO 3046	A	kW	2320

GENERAL CONDITIONS (for maximum power)

Number of cylinders			16
Intake air depression (new filter)	A	mbar	25
Intake air depression, max.	L	mbar	35

MODEL-RELATED DATA (basic design)

Number of cylinders			16
Cylinder configuration: V angle		degree	90
Bore		mm	165
Stroke		mm	190
Cylinder displacement		liter	4.06
Total displacement		liter	65.0
Number of inlet valves per cylinder			2
Number of exhaust valves per cylinder			2

TIM-ID: 0000003077 - 001

LUBE OIL SYSTEM

Number of cylinders			16
Lube-oil operating temperature before engine, from	R	°C	85
Lube oil temperature before engine, to	R	°C	90
Lube oil operating pressure before engine, from	R	bar	5.5
Lube oil operating pressure before engine, to	R	bar	6.0
Lube oil operating pressure (low idle) (meas. point: before engine)	R	bar	2.0

FUEL SYSTEM

Number of cylinders			16
Fuel pressure at engine supply connection, min. (when engine is starting)	L	bar	-0.1
Fuel pressure at supply connection to engine (when engine is running), min.	L	bar	-0.3
Fuel pressure at engine supply connection, max. (when engine is starting)	L	bar	1.5
Fuel supply flow, max.	R	liter/min	24.0

GENERAL OPERATING DATA

Number of cylinders			16
Firing speed, from	R	rpm	80
Firing speed, to	R	rpm	120

STARTING (electric)

Number of cylinders			16
Starter, rated voltage (standard design)	R	V=	24

STARTING (with pneumatic / hydraulic starter)

Number of cylinders			16
Starting air pressure before starter motor, min.	R	bar	18
Starting air pressure before starter motor, max.	R	bar	30

INCLINATIONS, STANDARD OIL SYSTEM (reference: waterline)

Number of cylinders			16
Longitudinal inclination, continuous max. driving end down (Option: max. operating inclinations)	L	degree	15
Longitudinal inclination, temporary max. driving end down (Option: max. operating inclinations)	L	degree	22.5
Longitudinal inclination, continuous max. driving end up (Option: max. operating inclinations)	L	degree	10
Transverse inclination, continuous max. (Option: max. operating inclinations)	L	degree	22.5

TIM-ID: 000000077 - 001

CAPACITIES

Number of cylinders			16
Engine oil at initial filling (standard oil system) (Option: max. operating inclinations)	R	liter	320
Oil change quantity, max. (standard oil system) (Option: max. operating inclinations)	R	liter	250
Oil pan capacity, dipstick mark min. (standard oil system) (Option: max. operating inclinations)	L	liter	190
Oil pan capacity, dipstick mark max. (standard oil system) (Option: max. operating inclinations)	L	liter	230

WEIGHTS / MAIN DIMENSIONS

Number of cylinders			16
Engine dry weight (with attached standard accessories, without coupling)	R	kg	7800

ACOUSTICS

Number of cylinders			16
Exhaust noise, unsilenced, BL, (free-field sound-pressure level Lp, 1m distance, ISO 6798)	R	db(A)	109
Engine surface noise with attenuated intake noise (filter) - BL (free-field sound pressure level Lp, 1m distance, ISO 6798)	R	db(A)	108

TIM-ID: 0000003077 - 001

3.8 16V 4000 M70 engine data: IMO, engine-mounted heat exchanger, copper-based alloy intercooler

Explanation:

DL Ref. value: Continuous power
BL Ref. value: Fuel stop power
A Design value
G Guaranteed value
R Guideline value
L Limit value, up to which the engine can be operated without changes (e.g. of power setting)
N Not yet defined value
- Not applicable
X Applicable

REFERENCE CONDITIONS

Engine model			16V 4000 M70
Application group			1B
Intake air temperature		°C	25
Raw water inlet temperature		°C	25
Barometric pressure		mbar	1000
Site altitude above sea level		m	100

POWER-RELATED DATA (power ratings are net brake power to ISO 3046)

Number of cylinders			16
Engine rated speed	A	rpm	2000
Fuel stop power ISO 3046	A	kW	2320

GENERAL CONDITIONS (for maximum power)

Number of cylinders			16
Intake air depression (new filter)	A	mbar	25
Intake air depression, max.	L	mbar	35

MODEL-RELATED DATA (basic design)

Number of cylinders			16
Cylinder configuration: V angle		degree	90
Bore		mm	165
Stroke		mm	190
Cylinder displacement		liter	4.06
Total displacement		liter	65.0
Number of inlet valves per cylinder			2
Number of exhaust valves per cylinder			2

TIM-ID: 0000003082 - 001

RAW-WATER CIRCUIT (open circuit)

Number of cylinders			16
Raw water pump: Inlet pressure, min.	L	bar	-0.2
Raw water pump: Inlet pressure , max.	L	bar	0.5
Pressure loss in the external raw-water system, max.	L	bar	1.7

LUBE OIL SYSTEM

Number of cylinders			16
Lube-oil operating temperature before engine, from	R	°C	85
Lube oil temperature before engine, to	R	°C	90
Lube oil operating pressure before engine, from	R	bar	5.5
Lube oil operating pressure before engine, to	R	bar	6.0
Lube oil operating pressure (low idle) (meas. point: before engine)	R	bar	2.0

FUEL SYSTEM

Number of cylinders			16
Fuel pressure at engine supply connection, min. (when engine is starting)	L	bar	-0.1
Fuel pressure at supply connection to engine (when engine is running), min.	L	bar	-0.3
Fuel pressure at engine supply connection, max. (when engine is starting)	L	bar	1.5
Fuel supply flow, max.	R	liter/min	24.0

GENERAL OPERATING DATA

Number of cylinders			16
Firing speed, from	R	rpm	80
Firing speed, to	R	rpm	120

STARTING (electric)

Number of cylinders			16
Starter, rated voltage (standard design)	R	V=	24

STARTING (with pneumatic / hydraulic starter)

Number of cylinders			16
Starting air pressure before starter motor, min.	R	bar	18
Starting air pressure before starter motor, max.	R	bar	30

TIM-ID: 0000003082 - 001

INCLINATIONS, STANDARD OIL SYSTEM (reference: waterline)

Number of cylinders			16
Longitudinal inclination, continuous max. driving end down (Option: max. operating inclinations)	L	degree	15
Longitudinal inclination, temporary max. driving end down (Option: max. operating inclinations)	L	degree	22.5
Longitudinal inclination, continuous max. driving end up (Option: max. operating inclinations)	L	degree	10
Transverse inclination, continuous max. (Option: max. operating inclinations)	L	degree	22.5

CAPACITIES

Number of cylinders			16
Engine coolant, engine-side (with cooler)	R	liter	290
Engine oil at initial filling (standard oil system) (Option: max. operating inclinations)	R	liter	320
Oil change quantity, max. (standard oil system) (Option: max. operating inclinations)	R	liter	250
Oil pan capacity, dipstick mark min. (standard oil system) (Option: max. operating inclinations)	L	liter	190
Oil pan capacity, dipstick mark max. (standard oil system) (Option: max. operating inclinations)	L	liter	230

WEIGHTS / MAIN DIMENSIONS

Number of cylinders			16
Engine dry weight (with attached standard accessories, without coupling)	R	kg	8000

ACOUSTICS

Number of cylinders			16
Exhaust noise, unsilenced, BL, (free-field sound-pressure level Lp, 1m distance, ISO 6798)	R	db(A)	109
Engine surface noise with attenuated intake noise (filter) - BL (free-field sound pressure level Lp, 1m distance, ISO 6798)	R	db(A)	108

TIM-ID: 0000003082 - 001

3.9 16V 4000 M70 engine data: IMO -20%, separate heat exchanger, copper-based alloy intercooler

Explanation:

DL Ref. value: Continuous power
BL Ref. value: Fuel stop power
A Design value
G Guaranteed value
R Guideline value
L Limit value, up to which the engine can be operated without changes (e.g. of power setting)
N Not yet defined value
- Not applicable
X Applicable

REFERENCE CONDITIONS

Engine model			16V 4000 M70
Application group			1B
Intake air temperature		°C	25
Raw water inlet temperature		°C	25
Barometric pressure		mbar	1000
Site altitude above sea level		m	100

POWER-RELATED DATA (power ratings are net brake power to ISO 3046)

Number of cylinders			16
Engine rated speed	A	rpm	2000
Fuel stop power ISO 3046	A	kW	2320

GENERAL CONDITIONS (for maximum power)

Number of cylinders			16
Intake air depression (new filter)	A	mbar	25
Intake air depression, max.	L	mbar	35

MODEL-RELATED DATA (basic design)

Number of cylinders			16
Cylinder configuration: V angle		degree	90
Bore		mm	165
Stroke		mm	190
Cylinder displacement		liter	4.06
Total displacement		liter	65.0
Number of inlet valves per cylinder			2
Number of exhaust valves per cylinder			2

TIM-ID: 0000003086 - 001

LUBE OIL SYSTEM

Number of cylinders			16
Lube-oil operating temperature before engine, from	R	°C	85
Lube oil temperature before engine, to	R	°C	90
Lube oil operating pressure before engine, from	R	bar	5.5
Lube oil operating pressure before engine, to	R	bar	6.0
Lube oil operating pressure (low idle) (meas. point: before engine)	R	bar	2.0

FUEL SYSTEM

Number of cylinders			16
Fuel pressure at engine supply connection, min. (when engine is starting)	L	bar	-0.1
Fuel pressure at supply connection to engine (when engine is running), min.	L	bar	-0.3
Fuel pressure at engine supply connection, max. (when engine is starting)	L	bar	1.5
Fuel supply flow, max.	R	liter/min	24.0

GENERAL OPERATING DATA

Number of cylinders			16
Firing speed, from	R	rpm	80
Firing speed, to	R	rpm	120

STARTING (electric)

Number of cylinders			16
Starter, rated voltage (standard design)	R	V=	24

STARTING (with pneumatic / hydraulic starter)

Number of cylinders			16
Starting air pressure before starter motor, min.	R	bar	18
Starting air pressure before starter motor, max.	R	bar	30

INCLINATIONS, STANDARD OIL SYSTEM (reference: waterline)

Number of cylinders			16
Longitudinal inclination, continuous max. driving end down (Option: max. operating inclinations)	L	degree	15
Longitudinal inclination, temporary max. driving end down (Option: max. operating inclinations)	L	degree	22.5
Longitudinal inclination, continuous max. driving end up (Option: max. operating inclinations)	L	degree	10
Transverse inclination, continuous max. (Option: max. operating inclinations)	L	degree	22.5

TIM-ID: 0000003086 - 001

CAPACITIES

Number of cylinders			16
Engine oil at initial filling (standard oil system) (Option: max. operating inclinations)	R	liter	320
Oil change quantity, max. (standard oil system) (Option: max. operating inclinations)	R	liter	250
Oil pan capacity, dipstick mark min. (standard oil system) (Option: max. operating inclinations)	L	liter	190
Oil pan capacity, dipstick mark max. (standard oil system) (Option: max. operating inclinations)	L	liter	230

WEIGHTS / MAIN DIMENSIONS

Number of cylinders			16
Engine dry weight (with attached standard accessories, without coupling)	R	kg	7800

ACOUSTICS

Number of cylinders			16
Exhaust noise, unsilenced, BL, (free-field sound-pressure level Lp, 1m distance, ISO 6798)	R	db(A)	109
Engine surface noise with attenuated intake noise (filter) - BL (free-field sound pressure level Lp, 1m distance, ISO 6798)	R	db(A)	108

TIM-ID: 0000003086 - 001

3.10 16V 4000 M70 engine data: IMO -20%, engine-mounted heat exchanger, copper-based alloy intercooler

Explanation:

DL Ref. value: Continuous power
BL Ref. value: Fuel stop power
A Design value
G Guaranteed value
R Guideline value
L Limit value, up to which the engine can be operated without changes (e.g. of power setting)
N Not yet defined value
- Not applicable
X Applicable

REFERENCE CONDITIONS

Engine model			16V 4000 M70
Application group			1B
Intake air temperature		°C	25
Raw water inlet temperature		°C	25
Barometric pressure		mbar	1000
Site altitude above sea level		m	100

POWER-RELATED DATA (power ratings are net brake power to ISO 3046)

Number of cylinders			16
Engine rated speed	A	rpm	2000
Fuel stop power ISO 3046	A	kW	2320

GENERAL CONDITIONS (for maximum power)

Number of cylinders			16
Intake air depression (new filter)	A	mbar	25
Intake air depression, max.	L	mbar	35

MODEL-RELATED DATA (basic design)

Number of cylinders			16
Cylinder configuration: V angle		degree	90
Bore		mm	165
Stroke		mm	190
Cylinder displacement		liter	4.06
Total displacement		liter	65.0
Number of inlet valves per cylinder			2
Number of exhaust valves per cylinder			2

TIM-ID: 0000003090 - 001

RAW-WATER CIRCUIT (open circuit)

Number of cylinders			16
Raw water pump: Inlet pressure, min.	L	bar	-0.2
Raw water pump: Inlet pressure , max.	L	bar	+0.5
Pressure loss in the external raw-water system, max.	L	bar	1.7

LUBE OIL SYSTEM

Number of cylinders			16
Lube-oil operating temperature before engine, from	R	°C	85
Lube oil temperature before engine, to	R	°C	90
Lube oil operating pressure before engine, from	R	bar	5.5
Lube oil operating pressure before engine, to	R	bar	6.0
Lube oil operating pressure (low idle) (meas. point: before engine)	R	bar	2.0

FUEL SYSTEM

Number of cylinders			16
Fuel pressure at engine supply connection, min. (when engine is starting)	L	bar	-0.1
Fuel pressure at supply connection to engine (when engine is running), min.	L	bar	-0.3
Fuel pressure at engine supply connection, max. (when engine is starting)	L	bar	1.5
Fuel supply flow, max.	R	liter/min	24.0

GENERAL OPERATING DATA

Number of cylinders			16
Firing speed, from	R	rpm	80
Firing speed, to	R	rpm	120

STARTING (electric)

Number of cylinders			16
Starter, rated voltage (standard design)	R	V=	24

STARTING (with pneumatic / hydraulic starter)

Number of cylinders			16
Starting air pressure before starter motor, min.	R	bar	18
Starting air pressure before starter motor, max.	R	bar	30

TIM-ID: 0000003090 - 001

INCLINATIONS, STANDARD OIL SYSTEM (reference: waterline)

Number of cylinders			16
Longitudinal inclination, continuous max. driving end down (Option: max. operating inclinations)	L	degree	15
Longitudinal inclination, temporary max. driving end down (Option: max. operating inclinations)	L	degree	22.5
Longitudinal inclination, continuous max. driving end up (Option: max. operating inclinations)	L	degree	10
Transverse inclination, continuous max. (Option: max. operating inclinations)	L	degree	22.5

CAPACITIES

Number of cylinders			16
Engine coolant, engine-side (with cooler)	R	liter	290
Engine oil at initial filling (standard oil system) (Option: max. operating inclinations)	R	liter	320
Oil change quantity, max. (standard oil system) (Option: max. operating inclinations)	R	liter	250
Oil pan capacity, dipstick mark min. (standard oil system) (Option: max. operating inclinations)	L	liter	190
Oil pan capacity, dipstick mark max. (standard oil system) (Option: max. operating inclinations)	L	liter	230

WEIGHTS / MAIN DIMENSIONS

Number of cylinders			16
Engine dry weight (with attached standard accessories, without coupling)	R	kg	8000

ACOUSTICS

Number of cylinders			16
Exhaust noise, unsilenced, BL, (free-field sound-pressure level Lp, 1m distance, ISO 6798)	R	db(A)	109
Engine surface noise with attenuated intake noise (filter) - BL (free-field sound pressure level Lp, 1m distance, ISO 6798)	R	db(A)	108

TIM-ID: 0000003090 - 001

3.11 16V 4000 M70 engine data: engine-mounted heat exchanger, EPA stage 2

Explanation:

DL Ref. value: Continuous power
BL Ref. value: Fuel stop power
A Design value
G Guaranteed value
R Guideline value
L Limit value, up to which the engine can be operated without changes (e.g. of power setting)
N Not yet defined value
- Not applicable
X Applicable

REFERENCE CONDITIONS

Engine model			16V 4000 M70
Application group			1B
Intake air temperature		°C	25
Raw water inlet temperature		°C	25
Barometric pressure		mbar	1000
Site altitude above sea level		m	100

POWER-RELATED DATA (power ratings are net brake power to ISO 3046)

Number of cylinders			16
Engine rated speed	A	rpm	2000
Fuel stop power ISO 3046	A	kW	2240

GENERAL CONDITIONS (for maximum power)

Number of cylinders			16
Intake air depression (new filter)	A	mbar	25
Intake air depression, max.	L	mbar	35

MODEL-RELATED DATA (basic design)

Number of cylinders			16
Cylinder configuration: V angle		degree	90
Bore		mm	165
Stroke		mm	190
Cylinder displacement		liter	4.06
Total displacement		liter	65.0
Number of inlet valves per cylinder			2
Number of exhaust valves per cylinder			2

TIM-ID: 0000011029 - 001

RAW-WATER CIRCUIT (open circuit)

Number of cylinders			16
Raw water pump: Inlet pressure, min.	L	bar	-0.2
Raw water pump: Inlet pressure , max.	L	bar	0.5
Pressure loss in the external raw-water system, max.	L	bar	1.7

LUBE OIL SYSTEM

Number of cylinders			16
Lube-oil operating temperature before engine, from	R	°C	85
Lube oil temperature before engine, to	R	°C	90
Lube oil operating pressure before engine, from	R	bar	5.5
Lube oil operating pressure before engine, to	R	bar	6.0
Lube oil operating pressure (low idle) (meas. point: before engine)	R	bar	2.0

FUEL SYSTEM

Number of cylinders			16
Fuel pressure at engine supply connection, min. (when engine is starting)	L	bar	-0.1
Fuel pressure at supply connection to engine (when engine is running), min.	L	bar	-0.3
Fuel pressure at engine supply connection, max. (when engine is starting)	L	bar	1.5
Fuel supply flow, max.	R	liter/min	24.0

GENERAL OPERATING DATA

Number of cylinders			16
Firing speed, from	R	rpm	80
Firing speed, to	R	rpm	120

STARTING (electric)

Number of cylinders			16
Starter, rated voltage (standard design)	R	V=	24

STARTING (with pneumatic / hydraulic starter)

Number of cylinders			16
Starting air pressure before starter motor, min.	R	bar	18
Starting air pressure before starter motor, max.	R	bar	30

TIM-ID: 0000011029 - 001

INCLINATIONS, STANDARD OIL SYSTEM (reference: waterline)

Number of cylinders			16
Longitudinal inclination, continuous max. driving end down (Option: max. operating inclinations)	L	degree	15
Longitudinal inclination, temporary max. driving end down (Option: max. operating inclinations)	L	degree	22.5
Longitudinal inclination, continuous max. driving end up (Option: max. operating inclinations)	L	degree	10
Transverse inclination, continuous max. (Option: max. operating inclinations)	L	degree	22.5

CAPACITIES

Number of cylinders			16
Engine coolant, engine-side (with cooler)	R	liter	290
Engine oil at initial filling (standard oil system) (Option: max. operating inclinations)	R	liter	320
Oil change quantity, max. (standard oil system) (Option: max. operating inclinations)	R	liter	250
Oil pan capacity, dipstick mark min. (standard oil system) (Option: max. operating inclinations)	L	liter	190
Oil pan capacity, dipstick mark max. (standard oil system) (Option: max. operating inclinations)	L	liter	230

WEIGHTS / MAIN DIMENSIONS

Number of cylinders			16
Engine dry weight (with attached standard accessories, without coupling)	R	kg	8000

ACOUSTICS

Number of cylinders			16
Exhaust noise, unsilenced, BL, (free-field sound-pressure level Lp, 1m distance, ISO 6798)	R	db(A)	113
Engine surface noise with attenuated intake noise (filter) - BL (free-field sound pressure level Lp, 1m distance, ISO 6798)	R	db(A)	108

TIM-ID: 0000011029 - 001

3.12 16V 4000 M70 engine data: separate heat exchanger, EPA stage 2

Explanation:

DL Ref. value: Continuous power
BL Ref. value: Fuel stop power
A Design value
G Guaranteed value
R Guideline value
L Limit value, up to which the engine can be operated without changes (e.g. of power setting)
N Not yet defined value
- Not applicable
X Applicable

REFERENCE CONDITIONS

Engine model			16V 4000 M70
Application group			1B
Intake air temperature		°C	25
Raw water inlet temperature		°C	25
Barometric pressure		mbar	1000
Site altitude above sea level		m	100

POWER-RELATED DATA (power ratings are net brake power to ISO 3046)

Number of cylinders			16
Engine rated speed	A	rpm	2000
Fuel stop power ISO 3046	A	kW	2240

GENERAL CONDITIONS (for maximum power)

Number of cylinders			16
Intake air depression (new filter)	A	mbar	25
Intake air depression, max.	L	mbar	35

MODEL-RELATED DATA (basic design)

Number of cylinders			16
Cylinder configuration: V angle		degree	90
Bore		mm	165
Stroke		mm	190
Cylinder displacement		liter	4.06
Total displacement		liter	65.0
Number of inlet valves per cylinder			2
Number of exhaust valves per cylinder			2

TIM-ID: 0000011032 - 001

LUBE OIL SYSTEM

Number of cylinders			16
Lube-oil operating temperature before engine, from	R	°C	85
Lube oil temperature before engine, to	R	°C	90
Lube oil operating pressure before engine, from	R	bar	5.5
Lube oil operating pressure before engine, to	R	bar	6.0
Lube oil operating pressure (low idle) (meas. point: before engine)	R	bar	2.0

FUEL SYSTEM

Number of cylinders			16
Fuel pressure at engine supply connection, min. (when engine is starting)	L	bar	-0.1
Fuel pressure at supply connection to engine (when engine is running), min.	L	bar	-0.3
Fuel pressure at engine supply connection, max. (when engine is starting)	L	bar	1.5
Fuel supply flow, max.	R	liter/min	24.0

GENERAL OPERATING DATA

Number of cylinders			16
Firing speed, from	R	rpm	80
Firing speed, to	R	rpm	120

STARTING (electric)

Number of cylinders			16
Starter, rated voltage (standard design)	R	V=	24

STARTING (with pneumatic / hydraulic starter)

Number of cylinders			16
Starting air pressure before starter motor, min.	R	bar	18
Starting air pressure before starter motor, max.	R	bar	30

INCLINATIONS, STANDARD OIL SYSTEM (reference: waterline)

Number of cylinders			16
Longitudinal inclination, continuous max. driving end down (Option: max. operating inclinations)	L	degree	15
Longitudinal inclination, temporary max. driving end down (Option: max. operating inclinations)	L	degree	22.5
Longitudinal inclination, continuous max. driving end up (Option: max. operating inclinations)	L	degree	10
Transverse inclination, continuous max. (Option: max. operating inclinations)	L	degree	22.5

TIM-ID: 0000011032 - 001

CAPACITIES

Number of cylinders			16
Engine oil at initial filling (standard oil system) (Option: max. operating inclinations)	R	liter	320
Oil change quantity, max. (standard oil system) (Option: max. operating inclinations)	R	liter	250
Oil pan capacity, dipstick mark min. (standard oil system) (Option: max. operating inclinations)	L	liter	190
Oil pan capacity, dipstick mark max. (standard oil system) (Option: max. operating inclinations)	L	liter	230

WEIGHTS / MAIN DIMENSIONS

Number of cylinders			16
Engine dry weight (with attached standard accessories, without coupling)	R	kg	7800

ACOUSTICS

Number of cylinders			16
Exhaust noise, unsilenced, BL, (free-field sound-pressure level Lp, 1m distance, ISO 6798)	R	db(A)	113
Engine surface noise with attenuated intake noise (filter) - BL (free-field sound pressure level Lp, 1m distance, ISO 6798)	R	db(A)	108

TIM-ID: 0000011032 - 001

3.13 12V 4000 M71 engine data: IMO, separate heat exchanger, copper-based alloy intercooler

Explanation:

DL Ref. value: Continuous power
BL Ref. value: Fuel stop power
A Design value
G Guaranteed value
R Guideline value
L Limit value, up to which the engine can be operated without changes (e.g. of power setting)
N Not yet defined value
- Not applicable
X Applicable

REFERENCE CONDITIONS

Engine model			12V 4000 M71
Application group			1B
Intake air temperature		°C	25
Raw water inlet temperature		°C	25
Barometric pressure		mbar	1000
Site altitude above sea level		m	100

POWER-RELATED DATA (power ratings are net brake power to ISO 3046)

Number of cylinders			12
Engine rated speed	A	rpm	2000
Fuel stop power ISO 3046	A	kW	1850

GENERAL CONDITIONS (for maximum power)

Number of cylinders			12
Intake air depression (new filter)	A	mbar	25
Intake air depression, max.	L	mbar	35

MODEL-RELATED DATA (basic design)

Number of cylinders			12
Cylinder configuration: V angle		degree	90
Bore		mm	165
Stroke		mm	190
Cylinder displacement		liter	4.06
Total displacement		liter	48.7
Number of inlet valves per cylinder			2
Number of exhaust valves per cylinder			2

TIM-ID: 0000003055 - 001

RAW-WATER CIRCUIT (open circuit)

Number of cylinders			12
Raw water pump: Inlet pressure, min.	L	bar	-0.2
Raw water pump: Inlet pressure , max.	L	bar	0.5
Pressure loss in the external raw-water system, max.	L	bar	1.5

LUBE OIL SYSTEM

Number of cylinders			12
Lube-oil operating temperature before engine, from	R	°C	85
Lube oil temperature before engine, to	R	°C	90
Lube oil operating pressure before engine, from	R	bar	5.5
Lube oil operating pressure before engine, to	R	bar	6.0
Lube oil operating pressure (low idle) (meas. point: before engine)	R	bar	2.0

FUEL SYSTEM

Number of cylinders			12
Fuel pressure at engine supply connection, min. (when engine is starting)	L	bar	-0.1
Fuel pressure at supply connection to engine (when engine is running), min.	L	bar	-0.3
Fuel pressure at engine supply connection, max. (when engine is starting)	L	bar	1.5
Fuel supply flow, max.	R	liter/min	20.0

GENERAL OPERATING DATA

Number of cylinders			12
Firing speed, from	R	rpm	80
Firing speed, to	R	rpm	120

STARTING (electric)

Number of cylinders			12
Starter, rated voltage (standard design)	R	V=	24

STARTING (with pneumatic / hydraulic starter)

Number of cylinders			12
Starting air pressure before starter motor, min.	R	bar	17
Starting air pressure before starter motor, max.	R	bar	30

TIM-ID: 0000003055 - 001

INCLINATIONS, STANDARD OIL SYSTEM (reference: waterline)

Number of cylinders			12
Longitudinal inclination, continuous max. driving end down (Option: max. operating inclinations)	L	degree	15
Longitudinal inclination, temporary max. driving end down (Option: max. operating inclinations)	L	degree	22.5
Longitudinal inclination, continuous max. driving end up (Option: max. operating inclinations)	L	degree	10
Transverse inclination, continuous max. (Option: max. operating inclinations)	L	degree	22.5

CAPACITIES

Number of cylinders			12
Engine coolant, engine-side (with cooler)	R	liter	250
Engine oil at initial filling (standard oil system) (Option: max. operating inclinations)	R	liter	265
Oil change quantity, max. (standard oil system) (Option: max. operating inclinations)	R	liter	215
Oil pan capacity, dipstick mark min. (standard oil system) (Option: max. operating inclinations)	L	liter	160
Oil pan capacity, dipstick mark max. (standard oil system) (Option: max. operating inclinations)	L	liter	200

WEIGHTS / MAIN DIMENSIONS

Number of cylinders			12
Engine dry weight (with attached standard accessories, without coupling)	R	kg	6800

ACOUSTICS

Number of cylinders			12
Exhaust noise, unsilenced, BL, (free-field sound-pressure level Lp, 1m distance, ISO 6798)	R	db(A)	111
Engine surface noise with attenuated intake noise (filter) - BL (free-field sound pressure level Lp, 1m distance, ISO 6798)	R	db(A)	105

TIM-ID: 0000003055 - 001

3.14 12V 4000 M71 engine data: IMO, engine-mounted heat exchanger, copper-based alloy intercooler

Explanation:

DL Ref. value: Continuous power
BL Ref. value: Fuel stop power
A Design value
G Guaranteed value
R Guideline value
L Limit value, up to which the engine can be operated without changes (e.g. of power setting)
N Not yet defined value
- Not applicable
X Applicable

REFERENCE CONDITIONS

Engine model			12V 4000 M71
Application group			1B
Intake air temperature		°C	25
Raw water inlet temperature		°C	25
Barometric pressure		mbar	1000
Site altitude above sea level		m	100

POWER-RELATED DATA (power ratings are net brake power to ISO 3046)

Number of cylinders			12
Engine rated speed	A	rpm	2000
Fuel stop power ISO 3046	A	kW	1850

GENERAL CONDITIONS (for maximum power)

Number of cylinders			12
Intake air depression (new filter)	A	mbar	25
Intake air depression, max.	L	mbar	35

MODEL-RELATED DATA (basic design)

Number of cylinders			12
Cylinder configuration: V angle		degree	90
Bore		mm	165
Stroke		mm	190
Cylinder displacement		liter	4.06
Total displacement		liter	48.7
Number of inlet valves per cylinder			2
Number of exhaust valves per cylinder			2

TIM-ID: 0000003063 - 001

LUBE OIL SYSTEM

Number of cylinders			12
Lube-oil operating temperature before engine, from	R	°C	85
Lube oil temperature before engine, to	R	°C	90
Lube oil operating pressure before engine, from	R	bar	5.5
Lube oil operating pressure before engine, to	R	bar	6.0
Lube oil operating pressure (low idle) (meas. point: before engine)	R	bar	2.0

FUEL SYSTEM

Number of cylinders			12
Fuel pressure at engine supply connection, min. (when engine is starting)	L	bar	-0.1
Fuel pressure at supply connection to engine (when engine is running), min.	L	bar	-0.3
Fuel pressure at engine supply connection, max. (when engine is starting)	L	bar	1.5
Fuel supply flow, max.	R	liter/min	19.5

GENERAL OPERATING DATA

Number of cylinders			12
Firing speed, from	R	rpm	80
Firing speed, to	R	rpm	120

STARTING (electric)

Number of cylinders			12
Starter, rated voltage (standard design)	R	V=	24

STARTING (with pneumatic / hydraulic starter)

Number of cylinders			12
Starting air pressure before starter motor, min.	R	bar	17
Starting air pressure before starter motor, max.	R	bar	30

INCLINATIONS, STANDARD OIL SYSTEM (reference: waterline)

Number of cylinders			12
Longitudinal inclination, continuous max. driving end down (Option: max. operating inclinations)	L	degree	15
Longitudinal inclination, temporary max. driving end down (Option: max. operating inclinations)	L	degree	22.5
Longitudinal inclination, continuous max. driving end up (Option: max. operating inclinations)	L	degree	10
Transverse inclination, continuous max. (Option: max. operating inclinations)	L	degree	22.5

TIM-ID: 0000003063 - 001

CAPACITIES

Number of cylinders			12
Engine oil at initial filling (standard oil system) (Option: max. operating inclinations)	R	liter	265
Oil change quantity, max. (standard oil system) (Option: max. operating inclinations)	R	liter	215
Oil pan capacity, dipstick mark min. (standard oil system) (Option: max. operating inclinations)	L	liter	160
Oil pan capacity, dipstick mark max. (standard oil system) (Option: max. operating inclinations)	L	liter	200

WEIGHTS / MAIN DIMENSIONS

Number of cylinders			12
Engine dry weight (with attached standard accessories, without coupling)	R	kg	6600

ACOUSTICS

Number of cylinders			12
Exhaust noise, unsilenced, BL, (free-field sound-pressure level Lp, 1m distance, ISO 6798)	R	db(A)	111
Engine surface noise with attenuated intake noise (filter) - BL (free-field sound pressure level Lp, 1m distance, ISO 6798)	R	db(A)	105

TIM-ID: 0000003063 - 001

3.15 12V 4000 M71 engine data: IMO, separate heat exchanger, copper-based alloy intercooler, intake air temperature 45°

Explanation:

DL Ref. value: Continuous power
BL Ref. value: Fuel stop power
A Design value
G Guaranteed value
R Guideline value
L Limit value, up to which the engine can be operated without changes (e.g. of power setting)
N Not yet defined value
- Not applicable
X Applicable

REFERENCE CONDITIONS

Engine model			12V 4000 M71
Application group			1B
Intake air temperature		°C	45
Raw water inlet temperature		°C	32
Barometric pressure		mbar	1000
Site altitude above sea level		m	100

POWER-RELATED DATA (power ratings are net brake power to ISO 3046)

Number of cylinders			12
Engine rated speed	A	rpm	2000
Fuel stop power ISO 3046	A	kW	1850

GENERAL CONDITIONS (for maximum power)

Number of cylinders			12
Intake air depression (new filter)	A	mbar	25
Intake air depression, max.	L	mbar	35

MODEL-RELATED DATA (basic design)

Number of cylinders			12
Cylinder configuration: V angle		degree	90
Bore		mm	165
Stroke		mm	190
Cylinder displacement		liter	4.06
Total displacement		liter	48.7
Number of inlet valves per cylinder			2
Number of exhaust valves per cylinder			2

TIM-ID: 0000003070 - 001

LUBE OIL SYSTEM

Number of cylinders			12
Lube-oil operating temperature before engine, from	R	°C	85
Lube oil temperature before engine, to	R	°C	90
Lube oil operating pressure before engine, from	R	bar	5.5
Lube oil operating pressure before engine, to	R	bar	6.0
Lube oil operating pressure (low idle) (meas. point: before engine)	R	bar	2.0

FUEL SYSTEM

Number of cylinders			12
Fuel pressure at engine supply connection, min. (when engine is starting)	L	bar	-0.1
Fuel pressure at supply connection to engine (when engine is running), min.	L	bar	-0.3
Fuel pressure at engine supply connection, max. (when engine is starting)	L	bar	1.5
Fuel supply flow, max.	R	liter/min	19.5

GENERAL OPERATING DATA

Number of cylinders			12
Firing speed, from	R	rpm	80
Firing speed, to	R	rpm	120

STARTING (electric)

Number of cylinders			12
Starter, rated voltage (standard design)	R	V=	24

STARTING (with pneumatic / hydraulic starter)

Number of cylinders			12
Starting air pressure before starter motor, min.	R	bar	17
Starting air pressure before starter motor, max.	R	bar	30

INCLINATIONS, STANDARD OIL SYSTEM (reference: waterline)

Number of cylinders			12
Longitudinal inclination, continuous max. driving end down (Option: max. operating inclinations)	L	degree	15
Longitudinal inclination, temporary max. driving end down (Option: max. operating inclinations)	L	degree	22.5
Longitudinal inclination, continuous max. driving end up (Option: max. operating inclinations)	L	degree	10
Transverse inclination, continuous max. (Option: max. operating inclinations)	L	degree	22.5

TIM-ID: 000000070 - 001

CAPACITIES

Number of cylinders			12
Engine oil at initial filling (standard oil system) (Option: max. operating inclinations)	R	liter	265
Oil change quantity, max. (standard oil system) (Option: max. operating inclinations)	R	liter	215
Oil pan capacity, dipstick mark min. (standard oil system) (Option: max. operating inclinations)	L	liter	160
Oil pan capacity, dipstick mark max. (standard oil system) (Option: max. operating inclinations)	L	liter	200

WEIGHTS / MAIN DIMENSIONS

Number of cylinders			12
Engine dry weight (with attached standard accessories, without coupling)	R	kg	6600

ACOUSTICS

Number of cylinders			12
Exhaust noise, unsilenced, BL, (free-field sound-pressure level Lp, 1m distance, ISO 6798)	R	db(A)	111
Engine surface noise with attenuated intake noise (filter) - BL (free-field sound pressure level Lp, 1m distance, ISO 6798)	R	db(A)	105

TIM-ID: 0000003070 - 001

3.16 16V 4000 M71 engine data: IMO, separate heat exchanger, copper-based alloy intercooler

Explanation:

DL Ref. value: Continuous power
BL Ref. value: Fuel stop power
A Design value
G Guaranteed value
R Guideline value
L Limit value, up to which the engine can be operated without changes (e.g. of power setting)
N Not yet defined value
- Not applicable
X Applicable

REFERENCE CONDITIONS

Engine model			16V 4000 M71
Application group			1B
Intake air temperature		°C	25
Raw water inlet temperature		°C	25
Barometric pressure		mbar	1000
Site altitude above sea level		m	100

POWER-RELATED DATA (power ratings are net brake power to ISO 3046)

Number of cylinders			16
Engine rated speed	A	rpm	2000
Fuel stop power ISO 3046	A	kW	2465

GENERAL CONDITIONS (for maximum power)

Number of cylinders			16
Intake air depression (new filter)	A	mbar	25
Intake air depression, max.	L	mbar	35

MODEL-RELATED DATA (basic design)

Number of cylinders			16
Cylinder configuration: V angle		degree	90
Bore		mm	165
Stroke		mm	190
Cylinder displacement		liter	4.06
Total displacement		liter	65.0
Number of inlet valves per cylinder			2
Number of exhaust valves per cylinder			2

TIM-ID: 0000003094 - 001

LUBE OIL SYSTEM

Number of cylinders			16
Lube-oil operating temperature before engine, from	R	°C	85
Lube oil temperature before engine, to	R	°C	90
Lube oil operating pressure before engine, from	R	bar	5.5
Lube oil operating pressure before engine, to	R	bar	6.0
Lube oil operating pressure (low idle) (meas. point: before engine)	R	bar	2.0

FUEL SYSTEM

Number of cylinders			16
Fuel pressure at engine supply connection, min. (when engine is starting)	L	bar	-0.1
Fuel pressure at supply connection to engine (when engine is running), min.	L	bar	-0.3
Fuel pressure at engine supply connection, max. (when engine is starting)	L	bar	1.5
Fuel supply flow, max.	R	liter/min	24.0

GENERAL OPERATING DATA

Number of cylinders			16
Firing speed, from	R	rpm	80
Firing speed, to	R	rpm	120

STARTING (electric)

Number of cylinders			16
Starter, rated voltage (standard design)	R	V=	24

STARTING (with pneumatic / hydraulic starter)

Number of cylinders			16
Starting air pressure before starter motor, min.	R	bar	18
Starting air pressure before starter motor, max.	R	bar	30

INCLINATIONS, STANDARD OIL SYSTEM (reference: waterline)

Number of cylinders			16
Longitudinal inclination, continuous max. driving end down (Option: max. operating inclinations)	L	degree	15
Longitudinal inclination, temporary max. driving end down (Option: max. operating inclinations)	L	degree	22.5
Longitudinal inclination, continuous max. driving end up (Option: max. operating inclinations)	L	degree	10
Transverse inclination, continuous max. (Option: max. operating inclinations)	L	degree	22.5

TIM-ID: 0000003094 - 001

CAPACITIES

Number of cylinders			16
Engine oil at initial filling (standard oil system) (Option: max. operating inclinations)	R	liter	320
Oil change quantity, max. (standard oil system) (Option: max. operating inclinations)	R	liter	250
Oil pan capacity, dipstick mark min. (standard oil system) (Option: max. operating inclinations)	L	liter	190
Oil pan capacity, dipstick mark max. (standard oil system) (Option: max. operating inclinations)	L	liter	230

WEIGHTS / MAIN DIMENSIONS

Number of cylinders			16
Engine dry weight (with attached standard accessories, without coupling)	R	kg	7800

ACOUSTICS

Number of cylinders			16
Exhaust noise, unsilenced, BL, (free-field sound-pressure level Lp, 1m distance, ISO 6798)	R	db(A)	109
Engine surface noise with attenuated intake noise (filter) - BL (free-field sound pressure level Lp, 1m distance, ISO 6798)	R	db(A)	108

TIM-ID: 0000003094 - 001

3.17 16V 4000 M71 engine data: IMO, engine-mounted heat exchanger, copper-based alloy intercooler

Explanation:

DL Ref. value: Continuous power
BL Ref. value: Fuel stop power
A Design value
G Guaranteed value
R Guideline value
L Limit value, up to which the engine can be operated without changes (e.g. of power setting)
N Not yet defined value
- Not applicable
X Applicable

REFERENCE CONDITIONS

Engine model			16V 4000 M71
Application group			1B
Intake air temperature		°C	25
Raw water inlet temperature		°C	25
Barometric pressure		mbar	1000
Site altitude above sea level		m	100

POWER-RELATED DATA (power ratings are net brake power to ISO 3046)

Number of cylinders			16
Engine rated speed	A	rpm	2000
Fuel stop power ISO 3046	A	kW	2465

GENERAL CONDITIONS (for maximum power)

Number of cylinders			16
Intake air depression (new filter)	A	mbar	25
Intake air depression, max.	L	mbar	35

MODEL-RELATED DATA (basic design)

Number of cylinders			16
Cylinder configuration: V angle		degree	90
Bore		mm	165
Stroke		mm	190
Cylinder displacement		liter	4.06
Total displacement		liter	65.0
Number of inlet valves per cylinder			2
Number of exhaust valves per cylinder			2

TIM-ID: 0000003098 - 001

RAW-WATER CIRCUIT (open circuit)

Number of cylinders			16
Raw water pump: Inlet pressure, min.	L	bar	-0.2
Raw water pump: Inlet pressure , max.	L	bar	0.5
Pressure loss in the external raw-water system, max.	L	bar	1.7

LUBE OIL SYSTEM

Number of cylinders			16
Lube-oil operating temperature before engine, from	R	°C	85
Lube oil temperature before engine, to	R	°C	90
Lube oil operating pressure before engine, from	R	bar	5.5
Lube oil operating pressure before engine, to	R	bar	6.0
Lube oil operating pressure (low idle) (meas. point: before engine)	R	bar	2.0

FUEL SYSTEM

Number of cylinders			16
Fuel pressure at engine supply connection, min. (when engine is starting)	L	bar	-0.1
Fuel pressure at supply connection to engine (when engine is running), min.	L	bar	-0.3
Fuel pressure at engine supply connection, max. (when engine is starting)	L	bar	1.5
Fuel supply flow, max.	R	liter/min	24.0

GENERAL OPERATING DATA

Number of cylinders			16
Firing speed, from	R	rpm	80
Firing speed, to	R	rpm	120

STARTING (electric)

Number of cylinders			16
Starter, rated voltage (standard design)	R	V=	24

STARTING (with pneumatic / hydraulic starter)

Number of cylinders			16
Starting air pressure before starter motor, min.	R	bar	18
Starting air pressure before starter motor, max.	R	bar	30

TIM-ID: 0000003098 - 001

INCLINATIONS, STANDARD OIL SYSTEM (reference: waterline)

Number of cylinders			16
Longitudinal inclination, continuous max. driving end down (Option: max. operating inclinations)	L	degree	15
Longitudinal inclination, temporary max. driving end down (Option: max. operating inclinations)	L	degree	22.5
Longitudinal inclination, continuous max. driving end up (Option: max. operating inclinations)	L	degree	10
Transverse inclination, continuous max. (Option: max. operating inclinations)	L	degree	22.5

CAPACITIES

Number of cylinders			16
Engine coolant, engine-side (with cooler)	R	liter	290
Engine oil at initial filling (standard oil system) (Option: max. operating inclinations)	R	liter	320
Oil change quantity, max. (standard oil system) (Option: max. operating inclinations)	R	liter	250
Oil pan capacity, dipstick mark min. (standard oil system) (Option: max. operating inclinations)	L	liter	190
Oil pan capacity, dipstick mark max. (standard oil system) (Option: max. operating inclinations)	L	liter	230

WEIGHTS / MAIN DIMENSIONS

Number of cylinders			16
Engine dry weight (with attached standard accessories, without coupling)	R	kg	8000

ACOUSTICS

Number of cylinders			16
Exhaust noise, unsilenced, BL, (free-field sound-pressure level Lp, 1m distance, ISO 6798)	R	db(A)	109
Engine surface noise with attenuated intake noise (filter) - BL (free-field sound pressure level Lp, 1m distance, ISO 6798)	R	db(A)	108

TIM-ID: 0000003098 - 001

3.18 16V 4000 M71 engine data: IMO, separate heat exchanger, copper-based alloy intercooler, intake air temperature 45°

Explanation:

DL Ref. value: Continuous power
BL Ref. value: Fuel stop power
A Design value
G Guaranteed value
R Guideline value
L Limit value, up to which the engine can be operated without changes (e.g. of power setting)
N Not yet defined value
- Not applicable
X Applicable

REFERENCE CONDITIONS

Engine model			16V 4000 M71
Application group			1B
Intake air temperature		°C	45
Raw water inlet temperature		°C	32
Barometric pressure		mbar	1000
Site altitude above sea level		m	100

POWER-RELATED DATA (power ratings are net brake power to ISO 3046)

Number of cylinders			16
Engine rated speed	A	rpm	2000
Fuel stop power ISO 3046	A	kW	2465

GENERAL CONDITIONS (for maximum power)

Number of cylinders			16
Intake air depression (new filter)	A	mbar	25
Intake air depression, max.	L	mbar	35

MODEL-RELATED DATA (basic design)

Number of cylinders			16
Cylinder configuration: V angle		degree	90
Bore		mm	165
Stroke		mm	190
Cylinder displacement		liter	4.06
Total displacement		liter	65.0
Number of inlet valves per cylinder			2
Number of exhaust valves per cylinder			2

TIM-ID: 0000003103 - 001

LUBE OIL SYSTEM

Number of cylinders			16
Lube-oil operating temperature before engine, from	R	°C	85
Lube oil temperature before engine, to	R	°C	90
Lube oil operating pressure before engine, from	R	bar	5.5
Lube oil operating pressure before engine, to	R	bar	6.0
Lube oil operating pressure (low idle) (meas. point: before engine)	R	bar	2.0

FUEL SYSTEM

Number of cylinders			16
Fuel pressure at engine supply connection, min. (when engine is starting)	L	bar	-0.1
Fuel pressure at supply connection to engine (when engine is running), min.	L	bar	-0.3
Fuel pressure at engine supply connection, max. (when engine is starting)	L	bar	1.5
Fuel supply flow, max.	R	liter/min	24.0

GENERAL OPERATING DATA

Number of cylinders			16
Firing speed, from	R	rpm	80
Firing speed, to	R	rpm	120

STARTING (electric)

Number of cylinders			16
Starter, rated voltage (standard design)	R	V=	24

STARTING (with pneumatic / hydraulic starter)

Number of cylinders			16
Starting air pressure before starter motor, min.	R	bar	18
Starting air pressure before starter motor, max.	R	bar	30

INCLINATIONS, STANDARD OIL SYSTEM (reference: waterline)

Number of cylinders			16
Longitudinal inclination, continuous max. driving end down (Option: max. operating inclinations)	L	degree	15
Longitudinal inclination, temporary max. driving end down (Option: max. operating inclinations)	L	degree	22.5
Longitudinal inclination, continuous max. driving end up (Option: max. operating inclinations)	L	degree	10
Transverse inclination, continuous max. (Option: max. operating inclinations)	L	degree	22.5

TIM-ID: 0000003103 - 001

CAPACITIES

Number of cylinders			16
Engine oil at initial filling (standard oil system) (Option: max. operating inclinations)	R	liter	320
Oil change quantity, max. (standard oil system) (Option: max. operating inclinations)	R	liter	250
Oil pan capacity, dipstick mark min. (standard oil system) (Option: max. operating inclinations)	L	liter	190
Oil pan capacity, dipstick mark max. (standard oil system) (Option: max. operating inclinations)	L	liter	230

WEIGHTS / MAIN DIMENSIONS

Number of cylinders			16
Engine dry weight (with attached standard accessories, without coupling)	R	kg	7800

ACOUSTICS

Number of cylinders			16
Exhaust noise, unsilenced, BL, (free-field sound-pressure level Lp, 1m distance, ISO 6798)	R	db(A)	109
Engine surface noise with attenuated intake noise (filter) - BL (free-field sound pressure level Lp, 1m distance, ISO 6798)	R	db(A)	108

TIM-ID: 0000003103 - 001

3.19 Firing order

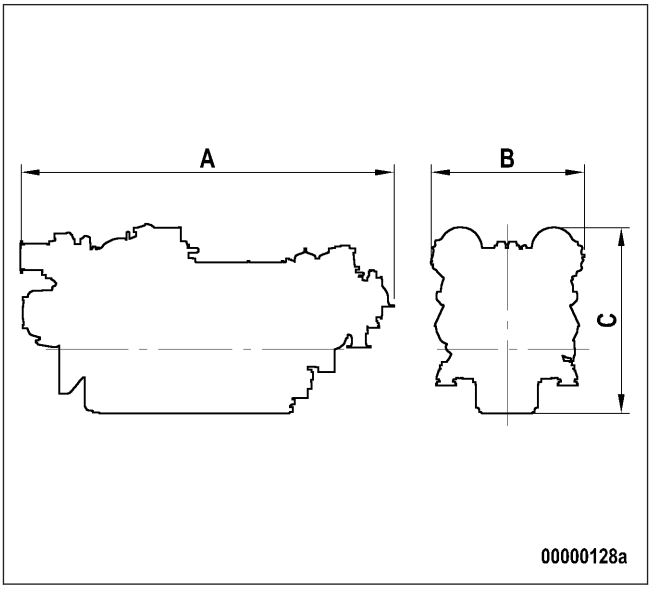
Firing order

Number of cylinders	Firing order
8V	A1-B4-A4-A2-B3-A3-B2-B1
12V	A1-B2-A5-B4-A3-B1-A6-B5-A2-B3-A4-B6
16 V	A1-A7-B4-B6-A4-B8-A2-A8-B3-B5-A3-A5-B2-A6-B1-B7
20 V	A1-B5-A8-B7-A5-B2-A7-B10-A2-B3-A10-B6-A3-B4-A6-B9-A4-B1-A9-B8

TIM-ID: 0000002794 - 004

3.20 Engine – Main dimensions

Engine – Main dimensions



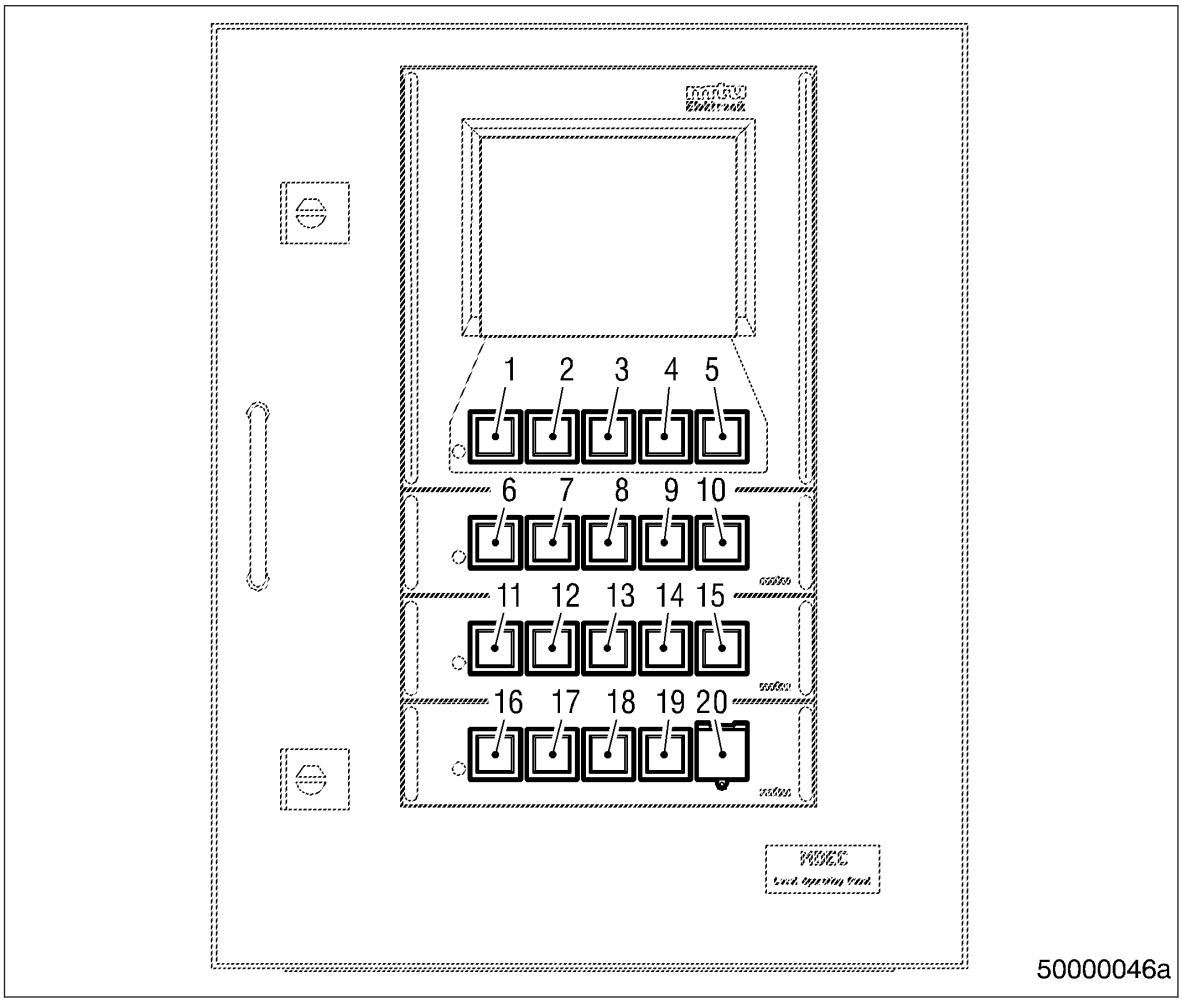
Engine model	Length (A)	Width (B)	Height (C)
8V 4000 M70	approx. 2340 mm	approx. 1380 mm	approx. 1750 mm
12V 4000 M70	approx. 3220 mm	approx. 1520 mm	approx. 1835 mm
12V 4000 M71	approx. 3220 mm	approx. 1520 mm	approx. 1835 mm
16V 4000 M70	approx. 3690 mm	approx. 1520 mm	approx. 1835 mm
16V 4000 M71	approx. 3690 mm	approx. 1520 mm	approx. 1835 mm

TIM-ID: 0000002164 - 002

4 Operation

4.1 LOP – Controls

LOP – Controls



Item	Color	Inscription	Meaning / Function
1	White	F1	Function keys to control the man-machine interface. Functions vary and are displayed on the LCD screen.
2	White	F2	
3	White	F3	
4	White	F4	
5	White	F5	
6	White	ALARM ACKNOWL	Pressing the button the first time stops alarm signalization. Pressing the button a second time acknowledges an active alarm. LED (spot) lights up when an alarm is active.
7	White	DIM ↑	Holding down the button increases LCD background illumination.

TIM-ID: 0000008861 - 002

Item	Color	Inscription	Meaning / Function
8	White	DIM ↓	Holding down the button decreases LCD background illumination.
9	White	LAMP TEST	Pressing the button initiates lamp test.
10	Red	TEST OVERSPEED	Pressing the button initiates overspeed test. LED (spot) lights up as long as the overspeed test is running.
11	Green	(depending on type of gearbox and propulsion)	FPP: Pressing the button engages gear ahead. CPP, WJ, VS: Pressing the button engages clutch. LED (spot) lights up when GCU feedback is active.
12	Green		FPP, CPP, WJ, VS: Pressing the button disengages clutch. LED (spot) lights up when GCU feedback is active.
13	Green		FPP: Pressing the button engages gear astern. CPP, VS: No function assigned. WJ: Holding down the button provides flushing of water jet intake channel (water-jet reverse) . LED (spot) lights up when GCU feedback is active.
14	White	ENGINE SPEED INCREASE	Engine speed is increased as long as the button is held down.
15	White	ENGINE SPEED DECREASE	Engine speed is decreased as long as the button is held down.
16	Green	READY FOR OPERATION	Pressing the button switches between "Not ready for operation" and "Ready for operation". LED (spot) is illuminated when the button is in the "Ready for operation" position.
17	Green	LOCAL CONTROL	Pressing the button switches between local operation and remote control. LED (spot) lights up when local mode is active.
18	White	START	Pressing the button initiates the automatic engine start sequence. LED (spot) lights up as long as the starting procedure is running.
19	White	STOP	Pressing the button initiates automatic engine stopping procedure. LED (spot) lights up as long as the STOP signal is available (also if transmitted from RCS).
20	Red	EMERGENCY STOP	Pressing the button initiates an immediate emergency engine stop. LED (spot) flashes once the emergency stop has been tripped and until the alarm has been acknowledged.

TIM-ID: 0000008861 - 002

4.2 Engine – Preparations for putting into operation after extended out-of-service periods (>3 months)

Preconditions

☑ Engine is stopped and starting disabled.

☑ MTU Fluids and Lubricants Specifications (A001061/..) are available.

Putting into operation after extended out-of-service periods (>3 months)

Item	Measure
Engine	Depreserve (→ MTU Fluids and Lubricants Specifications A001061/..).
Lube oil system	Check engine oil level (→ Page 155); preheat engine oil, if required. Bar engine with starting system.
Fuel prefilter	Fill with fuel (→ Page 143).
Fuel prefilter, pressure gauge	Align adjustable pointer with position of pressure indicator (→ Page 142).
Fuel system	Vent (→ Page 135).
Raw water pump (if raw water pump lies above the water line)	Fill with water (approx. 3 – 4 liters).
Coolant circuit	If engine is out of service for more than one year, change engine coolant (→ Page 165).
Coolant circuit	Check coolant level (→ Page 164).
Coolant circuit	Heat engine coolant with coolant preheating unit.
ECU	Check plug-in connections (→ Page 189).
Engine control system	Switch master switch to ON; Press READY FOR OPERATION button (→ Page 85).
LOP	Press LAMP TEST illuminated button (→ Page 85).

TIM-ID: 0000002208 - 004

4.3 Putting the engine into operation after scheduled out-of-service-period

Preconditions

☑ Engine is stopped and starting disabled.

Putting into operation

Item	Action
Lube oil system	Check engine oil level (→ Page 155); , preheat engine oil, if required.
Coolant circuit	Check coolant level (→ Page 164).
Coolant circuit	Heat engine coolant with coolant preheating unit.
Fuel prefilter	Drain water (→ Page 139); Check if suction-side pressure indicated at the fuel prefilter is within the limit (→ Page 142).
Engine control system	Switch master switch to ON; Press illuminated pushbutton READY FOR OPERATION (→ Page 85).
LOP	Press illuminated pushbutton LAMP TEST (→ Page 85).

TIM-ID: 0000002686 - 004

4.4 Tasks after extended out-of-service periods (>3 weeks)

Tasks after extended out-of-service periods (>3 weeks)

Note: Operate fuel treatment system for at least 5 minutes.

1. Start up fuel treatment system (→ Page 91).
2. Shut down fuel treatment system (→ Page 105).

TIM-ID: 0000007730 - 005

4.5 Checks prior to start-up

Checks prior to start-up

1. Check tank and the entire pipework for cleanness. If microorganisms are detected:
   a) Clean affected components.
   b) Disinfect affected components with biocides (→ MTU Fluids and Lubricants Specifications A001061/..).
2. Close drain valves on housing.
3. Open all supply and discharge valves.
4. Switch on fuel treatment system (→ Page 95).
5. Check direction of rotation of pump.
6. Vent bypass and fuel lines of the system.
   a) Open ball valve for pressure tank.
   b) Open ball valve for overflow tank.
   c) Close ball valve at the inlet to the fuel treatment system.

Result: Bypass line is vented via the overflow tank.

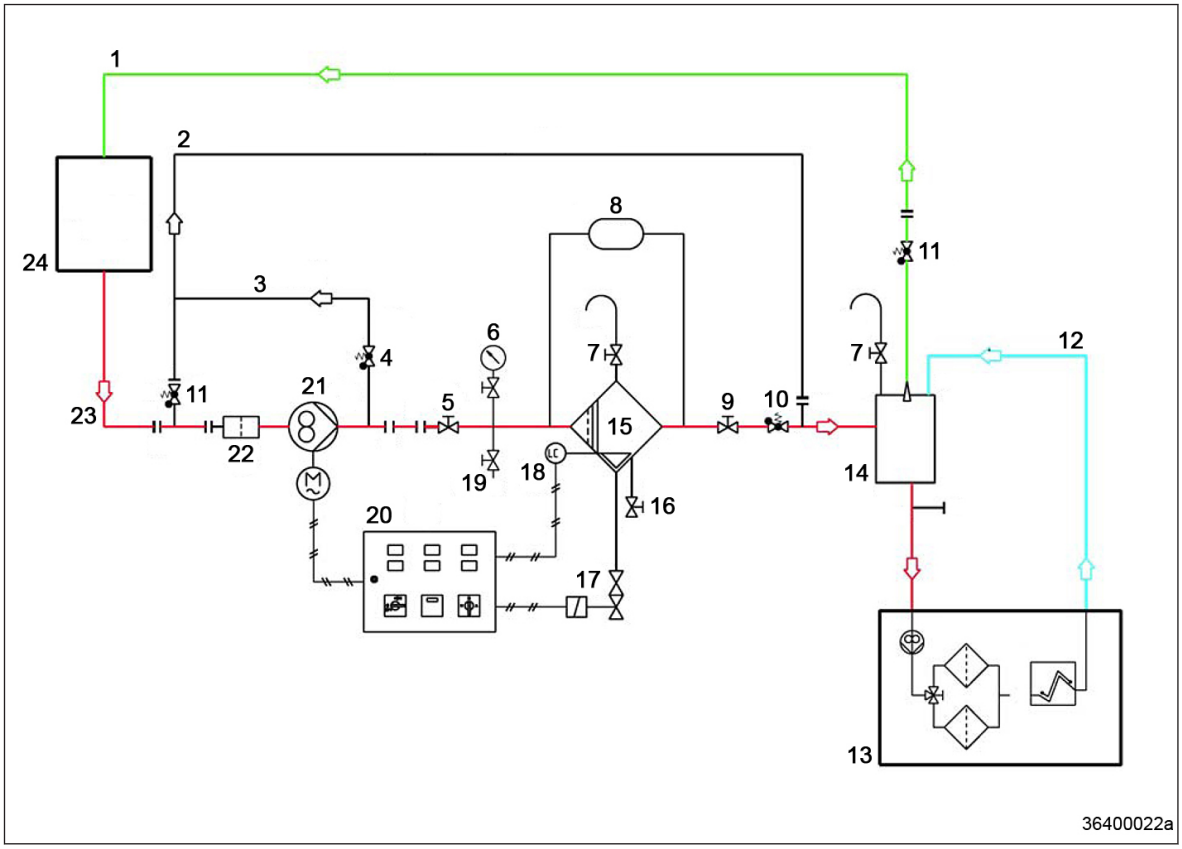
   d) Open ball valve at the inlet to the fuel treatment system.
7. Check the fuel treatment system for leaks.

Result: The fuel treatment system is ready for operation.

TIM-ID: 0000007736 - 005

4.6 Fuel treatment system – Putting into operation

Fuel treatment system – Overview



1. Switch on fuel treatment system (→ Page 95).
2. Check the differential pressure at differential pressure gauge (8). Differential pressure in a new system: 0.1 bar to 0.3 bar.

Result: If no differential pressure is measured, the coalescer filter element is probably being bypassed.

1. Remove coalescer filter element (→ Page 183).
2. Check sealing faces on coalescer filter element and in the pressure tank.

Initial operation: HAT

1. Replace fuel filter on engine (→ Page 137).

Note: Determine the suction pressure upstream of the engine-mounted fuel delivery pump.

2. Install a pressure gauge in the fuel supply line from the shipyard-side fuel system to the engine.
3. Switch on fuel treatment system and operate it for some minutes (→ Page 95).

Result: Fuel is sucked from the tank, dirt particles and water are filtered and separated, then the fuel is delivered via the overflow tank back to the tank. Water which has settled in the tank is separated.

4. Start engine (→ Page 93).
5. Run engine at idling speed.
6. Check suction pressure (see technical data of the engine) at the engine-mounted fuel delivery pump.

Note: If the suction pressure is within the permissible limits and engine operation is satisfactory:

7. Increase engine speed to 1000 rpm and monitor suction pressure.
8. Check suction pressure at the engine-mounted fuel delivery pump.

Result: If the values are within the limits specified by the manufacturer, the system is ready to start filter replacement simulation with the engine running as part of the Harbor Acceptance Tests.

TIM-ID: 0000007738 - 005

Simulation of filter replacement with the engine running: HAT

1. Switch on fuel treatment system (→ Page 95).
2. Start engine (→ Page 93).
3. Run engine at idling speed.
4. Close ball cock (5) at the inlet to the fuel treatment system.

Result: The pressure upstream of the fuel treatment system increases until the overflow valve at the pump unit opens and fuel flows through bypass (3) and bypass (2).

5. Open ball cock (19).

Result: Fuel emerges. If no fuel emerges:
- Open ball cock (5) at the inlet to the fuel treatment system.
- No function of bypasses (2) and (3); carry out functional test of bypasses (2) and (3).

6. Check suction pressure (see technical data of the engine) at the fuel delivery pump.

Note: If the suction pressure is within the permissible limits and engine operation is satisfactory:

7. Increase engine speed to 1000 rpm and monitor suction pressure.

Result: If all engine operating values are within the specified limits, open ball cock (5) at the inlet to the fuel treatment4 system.

Simulation of power failure (emergency): HAT

1. Switch on fuel treatment system (→ Page 95).
2. Start engine (→ Page 93).
3. Run engine at idling speed.
4. Switch off pump (21) on switch cabinet.

Result: The engine-mounted fuel delivery pump sucks fuel via bypass (2) directly from the tank.

5. Check suction pressure at the engine-mounted fuel delivery pump.

Note: If the suction pressure is within the permissible limits and engine operation is satisfactory.

6. Increase engine speed to 1000 rpm and monitor suction pressure.

Result: If the suction pressure is within the specified limits, simulation was successful.

Simulation of power failure (emergency): SAT

1. Switch on fuel treatment system (→ Page 95).
2. Start engine (→ Page 93).
3. Run engine at idling speed.
4. Switch off pump (21) on switch cabinet.

Result: The engine-mounted fuel delivery pump sucks fuel via bypass (2) directly from the tank.

5. Check suction pressure at the engine-mounted fuel delivery pump.

Note: If the suction pressure is within the permissible limits and engine operation is satisfactory:

6. Operate engine at full load and monitor suction pressure.

Result: If the suction pressure is within the specified limits, simulation was successful.

TIM-ID: 0000007738 - 005

4.7 Starting the engine from LOP

Preconditions

☑ Gearbox is in neutral position.

☑ External start interlock is not activated.

☑ Emergency air shutoff flaps (if fitted) are open.

DANGER

Unguarded rotating and moving engine components.
Risk of serious injury – danger to life!
- Before barring or starting the engine, make sure that nobody is in the danger zone.

WARNING

Engine noise above 85 dB (A).
Risk of damage to hearing!
- Wear ear protectors.

Barring engine (with out-of-service-period > 1 month)

Item	Action
Engine	Crank on starter (→ Page 113).

Starting the engine from LOP

Item	Action
Engine	Start in unloaded condition.
Plant	Switch on. LOP: • LOCAL OPERATION button lights up brightly (local control mode is active) (→ Page 85); • GEARBOX NEUTRAL button lights up brightly (gearbox is disengaged) (→ Page 85).
LOP	Press READY FOR OPERATION button briefly (→ Page 85). • READY FOR OPERATION button lights up brightly.
LOP	Press START button briefly (→ Page 85). • START button of the relevant engine lights up brightly; • Automatic starting sequence is performed; • Engine speed display instrument indicates increasing speed; • After completion of the starting sequence, the engine runs at idle speed, and the START button changes to basic brightness.

TIM-ID: 0000034452 - 001

4.8 Starting the engine at the BlueLine automation system (control stand)

DANGER

Unguarded rotating and moving engine components.
Risk of serious injury – danger to life!
- Before barring or starting the engine, make sure that nobody is in the danger zone.

WARNING

Engine noise above 85 dB (A).
Risk of damage to hearing!
- Wear ear protectors.

Barring engine (with out-of-service-period > 1 month)

Item	Action
Engine	Bar with starting system (→ Page 113).

Engine starting from the BlueLine automation system (control stand)

▶ (→ BlueLine documentation)

TIM-ID: 0000034453 - 001

4.9 Fuel treatment system – Switching on

Preconditions

☑ The on-board power supply is switched on.

CAUTION

Damage to engine/plant.
Major material damage!
- Before switching on, ensure that the engine/plant is ready for operation.
- Before switching on, ensure that all housings are closed.
- Before switching on, ensure that no work is in progress anywhere on the entire system.

Switching on fuel treatment system

1. Carry out checks prior to start-up (→ Page 90).
2. Switch on master switch on switch cabinet.

Result: Signal lamp “Control voltage present” lights up.

3. Switch on switch for pump.

Result: Signal lamp “Pump running” lights up.

TIM-ID: 0000007731 - 005

4.10 Operational checks

DANGER

Unguarded rotating and moving engine components.
Risk of serious injury – danger to life!
- Take special care when working on a running engine.

WARNING

Engine noise above 85 dB (A).
Risk of damage to hearing!
- Wear ear protectors.

Operational checks

Item	Action
Engine under load,	Visually inspect engine for leaks and general condition;
engine at nominal speed	Check speed, pressures and temperatures;
	Check engine and external lines for leaks;
	Check for abnormal running noises and vibration;
	Check exhaust color (→ Page 108).
HP pump	Check relief bore (→ Page 128).
Fuel prefilter	Check fuel prefilter maintenance indicator for max. admissible value (→ Page 142).
	Drain off water and dirt (→ Page 139)
Intercooler	Check drain line for water discharge and obstruction (→ Page 147).
Air filter	Check signal ring position of service indicator (→ Page 152).
	Replace air filter (→ Page 148), if the signal ring is completely visible in the service indicator control window.
Exhaust system	Check the drain for obstructions.
HT coolant pump	Check relief bore for oil and coolant discharge and contamination (→ Page 170).
Raw water pump	Check relief bore for oil and water discharge and contamination (→ Page 172)

TIM-ID: 0000002279 - 002

4.11 Clutch – Engaging from LOP

Preconditions

☑ LOCAL OPERATION button is illuminated brightly (local operating mode is active).

☑ Engine speed is within range for clutch engagement.

☑ No external clutch engagement interlock is activated.

DANGER

Vessel is sailing blind.
In Local Operation mode, the propulsion plant is controlled from the engine room.
Risk of accidents!
- Only execute vessel movements on the instructions of a person who has visual contact with the area outside the vessel.

Engaging clutch without reversing gearbox (CPP, WJ, VS)

Item	Action
LOP	Press CLUTCH IN button (→ Page 85). • CLUTCH IN button flashes. • Clutch is engaged. • After receiving the feedback signal from clutch, the CLUTCH IN button is illuminated brightly.

Engaging clutch in ahead direction with reversing gearbox (FPP, WJ)

Item	Action
LOP	Press CLUTCH AHEAD button (→ Page 85). • CLUTCH AHEAD button flashes. • Gearbox is engaged in AHEAD direction. • After receiving the feedback signal from clutch, the CLUTCH AHEAD button is illuminated brightly.

Engaging clutch in astern direction with reversing gearbox (FPP)

Item	Action
LOP	Press CLUTCH ASTERN button (→ Page 85). • CLUTCH ASTERN button flashes. • Gearbox is engaged astern. • After receiving the feedback signal from clutch, the CLUTCH ASTERN button is illuminated brightly.

TIM-ID: 0000002700 - 003

4.12 Clutch – Disengaging from LOP

Preconditions

☑ LOCAL OPERATION button is illuminated brightly (local operating mode is active).

☑ Engine speed in disengagement window.

Disengaging clutch without reversing gearbox (CPP, WJ, VS)

Item	Action
LOP	Press CLUTCH OUT button (→ Page 85). • CLUTCH OUT button flashes. • Clutch is disengaged. • After receiving the feedback signal from clutch, the CLUTCH OUT button is illuminated brightly.

Disengaging clutch with reversing gearbox (FPP, WJ)

Item	Action
LOP	Press CLUTCH NEUTRAL button (→ Page 85). • CLUTCH NEUTRAL button flashes. • Gearbox is disengaged (neutral position). • After receiving the feedback signal from clutch, the CLUTCH NEUTRAL button is illuminated brightly.

TIM-ID: 0000002810 - 003

4.13 Waterjet – Flushing from LOP (optional)

Preconditions

☑ LOCAL OPERATION button is illuminated brightly (local operating mode is active).

☑ Vessel at a standstill and Waterjet bucket below the waterline.

☑ Engine speed is within range for clutch engagement.

☑ No external clutch engagement interlock is activated.

CAUTION

Waterjet flushing puts excessive strain on the bearings.
Bearing damage!
- Do not flush waterjet for too long.
- Follow instructions of the waterjet manufacturer.

Flushing with reversing gearbox and flushing mode

Item	Action
LOP	Press FLUSH button and keep pressed (→ Page 85). • FLUSH button flashes. • Gearbox is engaged astern. • After receiving the feedback signal from clutch, the FLUSH button is illuminated brightly.
LOP	Release FLUSH button. • FLUSH button flashes. • Gearbox is disengaged (neutral position). • Illumination of FLUSH button is switched off as soon as the feedback signal from clutch is received.

TIM-ID: 0000002330 - 004

4.14 Stopping the engine from LOP

Preconditions

☑ Engine is running in local mode.

CAUTION

Stopping the engine when it is running at full load causes extreme stress to the engine.
Risk of overheating, damage to components!
- Before shutting down, disengage gear and run the engine at idle speed for at least 10 mins. until engine temperatures have dropped and constant values are displayed.

Stopping the engine from LOP

Item	Action
LOP	Disengage gearbox (→ Page 85).
LOP	Operate engine at idle speed (→ Page 85).
Temperature indications	Wait until engine temperatures do not fall any further.
LOP	Press STOP button (→ Page 85). • STOP button is illuminated; • Engine at a standstill.

TIM-ID: 0000002300 - 003

4.15 Stopping the engine at the BlueLine automation system (control stand)

CAUTION

Stopping the engine when it is running at full load causes extreme stress to the engine.
Risk of overheating, damage to components!
- Before shutting down, disengage gear and run the engine at idle speed for at least 10 mins. until engine temperatures have dropped and constant values are displayed.

Stopping the engine at the BlueLine automation system (control stand)

Item	Measure
Engine	Stop the engine at the BlueLine automation system (control stand) (→ BlueLine Operating Instructions).

TIM-ID: 0000002702 - 003

4.16 Emergency stop from LOP

CAUTION

An emergency stop causes extreme stress to the engine.
Risk of overheating, damage to components!
- Initiate emergency stop only in emergency situations.

Emergency stop from LOP

Item	Action
LOP	Open cap of EMERGENCY STOP button (→ Page 85).
LOP	Press EMERGENCY STOP button. • Engine is stopped by disconnecting the power supply to the ECU; • On engines with emergency air-shutoff flaps: flaps close; • EMERGENCY STOP button flashes, Horn, flashing lamp etc. are tripped.

After emergency stop from LOP

Item	Action
LOP	Press ALARM ACKNOWLEDGE button (→ Page 85). • Audible and visual alarm signaling stops.
LOP	Press ALARM ACKNOWLEDGE button again. • Power supply to ECU is provided; • Alarm has been acknowledged.
Engine	On engines with emergency air-shutoff flaps: open flaps. • Engine is ready for starting.

TIM-ID: 0000002314 - 002

4.17 Engine emergency stop at BlueLine automation system (control stand)

CAUTION

An emergency stop causes extreme stress to the engine.
Risk of overheating, damage to components!
- Initiate emergency stop only in emergency situations.

Engine emergency stop at BlueLine automation system

Item	Action
Engine	Emergency stop at BlueLine automation system (→ BlueLine Operating Instructions).

TIM-ID: 0000002704 - 003

4.18 After stopping the engine

Preconditions

☑ MTU Fluids and Lubricants Specifications (A001061/..) are available.

After stopping the engine

Item	Action
Coolant circuit	Drain coolant (→ Page 166) if: • freezing temperatures are expected and the engine is to remain out of service for an extended period, but engine coolant has no antifreeze additive; • the engine room is not heated; • the coolant is not kept at a suitable temperature; • the antifreeze concentration is insufficient for the engine-room temperature; • antifreeze concentration is 50 % and engine-room temperature is below -40 °C.
Raw water	Drain • If freezing temperatures are to be expected and the engine is to remain out of service for an extended period.
Engine control system	Switch off.
Air intake and exhaust system	Out-of-service-period > 1 week • Seal engine's air and exhaust sides.
Engine	Out-of-service-period > 1 month • Preserve engine (→ MTU Fluids and Lubricants Specifications A001061/..)

TIM-ID: 0000002324 - 006

4.19 Fuel treatment system – Shutdown

Shutting down fuel treatment system

1. Press the illuminated pushbutton "Water drain" on the switch cabinet until water discharge from the outlet stops.
2. Switch off fuel treatment system.
3. Close ball valve at the inlet to the fuel treatment system.
4. Close ball valve at the outlet of the fuel treatment system.
5. Open drain valve until pressure has escaped from fuel treatment system.

TIM-ID: 0000007732 - 005

4.20 Plant – Cleaning

Preconditions

☑ Engine is stopped and starting disabled.

☑ Operating voltage is not applied.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Steam jet cleaner	-	1
Cleaner (Hakupur 312)	30390	1

WARNING

Compressed air
Risk of injury!
- Do not direct compressed-air jet at persons.
- Wear protective goggles / safety mask and ear protectors.

WARNING

Water jet.
Risk of injury and scalding!
- Do not direct water jet at persons.
- Wear protective clothing, gloves, and goggles / safety mask.

CAUTION

Excessive reaction time of cleaning agents on components.
Damage to component!
- Observe manufacturer's instructions.
- Wear protective clothing, gloves, and goggles / safety mask.

Note: There is a risk of damaging sensors with compressed air.

Plant – Cleaning

1. Carry out plant cleaning only in areas where an appropriate oil separator is provided (environmental protection).
2. Prior to putting the cleaning unit into operation, read the Operating Instructions of the water/steam jet unit carefully and observe the safety precautions.
3. For external cleaning with high-pressure jet, use a flat-mouth nozzle only.
4. Carry out external cleaning as follows:
   a) Remove coarse dirt.
   b) Spray on cleaner sparingly and leave it for 1 to 5 minutes.
   c) Use the high-pressure jet to remove the loosened dirt.
   d) During external cleaning of the plant with water/steam-jet units, the pressure of the high-pressure jet (cleaning jet) must not exceed 50 bar. A minimum distance between spray nozzle and plant of 1 m must be observed. The temperature of the cleaning medium must not exceed 80 °C.

TIM-ID: 0000010171 - 021

5 Maintenance

5.1 Maintenance task reference table [QL1]

The maintenance tasks and intervals for this product are defined in the Maintenance Schedule. The Maintenance Schedule is a stand-alone publication.

The task numbers in this table provide reference to the maintenance tasks specified in the Maintenance Schedule.

Task	Measures	
W0500	Check engine oil level	(→ Page 155)
W0501	Visually inspect engine for leaks and general condition	(→ Page 96)
W0502	Check intercooler drain (if fitted)	(→ Page 147)
W0503	Check air filter service indicator	(→ Page 152)
W0504	Check HP fuel pump telltale bores	(→ Page 96)
W0505	Check relief bores of coolant pump(s)	(→ Page 170)
W0506	Check engine for abnormal running noises, exhaust color and vibrations	(→ Page 96)
W0507	Drain water and dirt from fuel prefilter (if fitted)	(→ Page 96)
W0508	Check contamination indicator reading on fuel prefilter (if fitted)	(→ Page 96)
W1001	Replace fuel filter or fuel filter element	(→ Page 137)
W1005	Replace air filter	(→ Page 148)
W1006	Replace fuel injectors	(→ Page 129)
W1008	Replace engine oil filter at each oil change or when the time limit (years) is reached, at the latest	(→ Page 159)
W1009	Check layer thickness of oil residue, clean and replace filter sleeve (if fitted)	(→ Page 161)
W1011	Perform endoscopic inspection of combustion chambers	(→ Page 114)
W1012	Crankcase breather, 8V only: Replace filter	(→ Page 119)
W1014	Crankcase breather, 12/16V only: Replace filter	(→ Page 119)
W1016	Battery-charging generator: Check condition of coupling	(→ Page 173)
W1029	Check air pipework between air filter and turbocharger for leaks and damage	(→ Page 154)
W1076	Exhaust turbocharger: Clean compressor wheel	(→ Page 145)
W1207	Check valve clearance, adjust if necessary. IMPORTANT! First adjustment after 1,000 operating hours!	(→ Page 122)
W1244	Check operation of rod electrode (if fitted)	(→ Page 181)
W1245	Check alarm function of differential pressure gauge (if fitted)	(→ Page 180)
W1246	Check pump capacity (if fitted)	(→ Page 182)

Table 1: Maintenance task reference table [QL1]

TIM-ID: 0000034059 - 002

6 Troubleshooting

6.1 Troubleshooting

Engine does not turn when starter is actuated

Component	Cause	Measure
Battery	Discharged or faulty	Charge or replace (see manufacturer's documentation).
	Cable connections faulty	Check if cable connections are properly secured (see manufacturer's documentation).
Starter	Engine cabling or starter faulty	Check if cable connections are properly secured, contact Service.
Engine wiring	Faulty	Check (→ Page 185).
LOP	Seating of assemblies or plug connectors possibly loose	Perform visual inspection (→ Page 193).
ECU	Seating of plug connections possibly loose	Check plug connections (→ Page 189).
Engine	Running gear blocked (engine cannot be barred manually)	Contact Service.

Engine turns but does not fire

Component	Cause	Measure
Starter	Poor rotation by starter: Battery discharged or faulty	Charge or replace battery (see manufacturer's documentation).
Engine wiring	Faulty	Check (→ Page 185).
Fuel system	Air in fuel system	Vent fuel system (→ Page 135).
ECU	Faulty	Contact Service.

Engine fires unevenly

Component	Cause	Measure
Fuel injection equipment	Injector faulty	Replace (→ Page 129).
Engine wiring	Faulty	Check (→ Page 185).
Fuel system	Air in fuel system	Vent fuel system (→ Page 135).
ECU	Faulty	Contact Service.

Engine does not reach rated speed

Component	Cause	Measure
Fuel supply	Fuel prefilter clogged	Replace (→ Page 143).
	Easy-change fuel filter clogged	Replace (→ Page 137).
Air supply	Air filter clogged	Check signal ring position of contamination indicator (→ Page 152).

TIM-ID: 0000002550 - 002

Component	Cause	Measure
Fuel injection equipment	Injector faulty	Replace (→ Page 129).
Engine wiring	Faulty	Check (→ Page 185).
Engine	Overloaded	Contact Service.

Engine speed not steady

Component	Cause	Measure
Fuel injection equipment	Injector faulty	Replace (→ Page 129).
Speed sensor	Faulty	Contact Service.
Fuel system	Air in fuel system	Vent fuel system (→ Page 135).
ECU	Faulty	Contact Service.

Charge-air temperature too high

Component	Cause	Measure
Engine coolant	Engine coolant treatment incorrect	Check (MTU test kit).
Intercooler	Contaminated	Contact Service.
Engine room	Air-intake temperature too high	Check fans and air supply / ventilation ducts.

Charge-air pressure too low

Component	Cause	Measure
Air supply	Air filter clogged	Check signal ring position of contamination indicator (→ Page 152).
Intercooler	Contaminated	Contact Service.
Exhaust turbocharger	Faulty	Contact Service.

Coolant leaks at intercooler

Component	Cause	Measure
Intercooler	Leaking, major coolant discharge	Contact Service.

Black exhaust gas

Component	Cause	Measure
Air supply	Air filter clogged	Check signal ring position of contamination indicator (→ Page 152).
Fuel injection equipment	Injector faulty	Replace (→ Page 129).
Engine	Overloaded	Contact Service.

TIM-ID: 0000002550 - 002

Blue exhaust gas

Component	Cause	Measure
Engine oil	Too much oil in engine	Drain engine oil (→ Page 156).
	Oil separator or oil preseparator of crankcase breather clogged	Replace.
Exhaust turbocharger, cylinder head, piston rings, cylinder liner	Faulty	Contact Service.

White exhaust gas

Component	Cause	Measure
Engine	Not at operating temperature	Run engine to reach operating temperature.
Fuel system	Water in fuel	Check fuel system at fuel prefilter Drain fuel prefilter (→ Page 139).
Intercooler	Leaking	Contact Service.

TIM-ID: 0000002550 - 002

6.2 LOP fault messages

Fault messages and measuring points (status reports) are displayed as text messages on the LOP display (DIS). Explanation of the displayed texts can be gathered by pressing the help button on the touch screen. Fault messages can also be caused by faulty sensors/actuators. Contact Service to have sensors/actuators checked and replaced as necessary if the troubleshooting measures listed in the table below prove unsuccessful.

TIM-ID: 0000008902 - 003

7 Task Description

7.1 Engine

7.1.1 Engine – Barring manually

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Barring device	F6555766	1
Ratchet head with extension	F30006212	1

DANGER

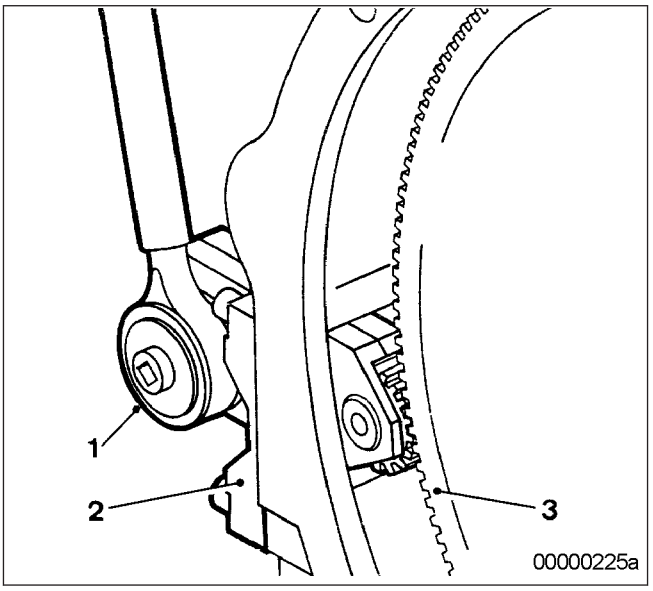
Unguarded rotating and moving engine components.
Risk of serious injury – Danger to life!
- Before barring the engine, ensure that nobody is in the danger zone.

Engine – Barring manually

1. Remove guard plate.

Result: Safety switch preventing engine starting activated.

2. Engage barring device (2) in ring gear (3) and install on flywheel housing.
3. Apply ratchet (1) to barring device (2).
4. Rotate crankshaft in engine direction of rotation. Apart from the normal compression resistance, there should be no resistance.
5. For barring device removal, follow reverse sequence of working steps.



TIM-ID: 0000010503 - 003

7.1.2 Engine – Barring with starting system

Barring using the automation system

Refer to automation system operating instructions

TIM-ID: 0000017532 - 003

7.2 Cylinder Liner

7.2.1 Cylinder liner – Endoscopic examination

Preconditions

☑ Engine is stopped and starting disabled

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Rigid endoscope	Y20097353	1

Preparatory steps

1. Remove cylinder head cover (→ Page 127).
2. Remove injector (→ Page 130).

Positioning crankshaft at BDC

1. Using barring gear, turn crankshaft until crankshaft journal of the cylinder to be inspected has reached BDC.
2. Insert endoscope into cylinder liner through injector seat.

Endoscopic examination of cylinder liner

Findings	Action
• Thin carbon coating on circumference of carbon scraper ring • Slight localized additive deposits at top edge • Localized smooth areas on bottom edge • Carbon deposits on circumference in clearance between top piston ring and bottom edge of carbon scraper ring • First signs of marks left by top piston ring • Bright mark on entire circumference • Consistent honing pattern without objections • First signs of marks left by lower cooling bores • Running pattern seems darker	No action required
• Dark areas with even or varying degrees of discoloration • Beginning and end of the discoloration are not sharply defined and do not cover the entire stroke area • Dark areas in the upper section of the cooling bore, remaining circumference without objections • Piston rings without objections	Further endoscopic examination required as part of maintenance work
• On the entire circumference, apart from light areas of discoloration (that do not impair operation) clearly darker stripes that start at the top piston ring • Heat discoloration in the direction of stroke and honing pattern damage • Heat discoloration of piston rings	Cylinder liner must be replaced; Service must be contacted

1. Compile endoscopy report using the table.
2. Use technical terms for description of the liner surface (→ Page 116).
3. Depending on findings:
   - do not take any action or
   - carry out a further endoscopic examination as part of maintenance work or
   - contact Service; cylinder liner must be replaced.

TIM-ID: 0000000015 - 013

Final steps

1. Install injector (→ Page 130).
2. Install cylinder head cover (→ Page 127).

TIM-ID: 0000000015 - 013

7.2.2 Cylinder liner – Instructions and comments on endoscopic and visual examination

Terms used for endoscopic examination

Use the terms listed below to describe the condition of the cylinder-liner surface in the endoscopic examination report.

Findings	Measure
Minor dirt scores	Minor dirt scores can occur during the assembly of a new engine (honing products, particles, broken-off burrs). Removed cylinders clearly show such scoring on the running surface under endoscope magnification. Cannot be felt with the fingernail. Findings not critical.
Single scores	Clearly visible scores caused by hard particles. They usually start in the TDC area and cross through the hone pattern in the direction of stroke. Findings not critical.
Scored area	These areas consist of scores of different length and depth next to one another. In most cases, they are found at the 6-o'clock and 12-o'clock positions (inlet/exhaust) along the transverse engine axis. Findings not critical.
Smoothened area	Smoothened areas are on the running surface but almost the whole honing pattern is still visible. Smoothened areas appear brighter and more brilliant than the surrounding running surface. Findings not critical.
Bright area	Bright areas are on the running surface and show local removal of the honing pattern. Grooves from honing process are not visible any more.
Discoloration	This is caused by oxidation (surface discoloration through oil or fuel) and temperature differences around the liner. It appears rather darker within the honed structure in contrast to the bright metallic running surface. The honing pattern is undisturbed. Discolorations extend in stroke direction and may be interrupted. Findings not critical.
Corrosion fields / spots	Corrosion fields / spots result from water (condensed water) with the valves in the overlap (open) position. They are clearly visible due to the dark color of the honing groove bottom. This corrosion is not critical unless there is corrosion pitting.
Black lines	Black lines are a step towards heat discoloration. They are visible as a clear discoloration from TDC to BDC in the running surface and the start of localized damage to the honing pattern. Cylinder liners with a large number of black lines around the running surface have limited service life and should be replaced.

TIM-ID: 000000014 - 013

Findings	Measure
Burn mark	This is caused by a malfunction in the liner / ring tribosystem. Usually they run over the whole ring-travel area (TDC/BDC), starting at the first TDC-ring and becoming more visible from the second TDC-ring 2 onwards and less pronounced from TDC-ring 1. The honing pattern is usually no longer visible and displays a clearly defined (straight) edge to the undisturbed surface. The damaged surface is usually discolored. The circumferential length varies. Liners with burn marks, or heat discoloration, starting in TDC ring 1 have to be replaced.
Seizure marks, scuffing	Irregular circumference lengths and depths. Can be caused either by the piston skirt or the piston crown. Material deposits on the liner (smear), heavy discoloration. Severe, visible scoring. Replace liner.

Evaluation of findings and further measures

The findings in the start phase of oxidation discoloration and heat discoloration are similar. A thorough investigation and compliance with the above evaluation criteria allow an unambiguous evaluation. To avoid unnecessary disassembly work, it is recommended that another inspection be carried out after further operation of the engine.

TIM-ID: 0000000014 - 013

7.3 Crankcase Breather

7.3.1 Crankcase breather – Oil separator check

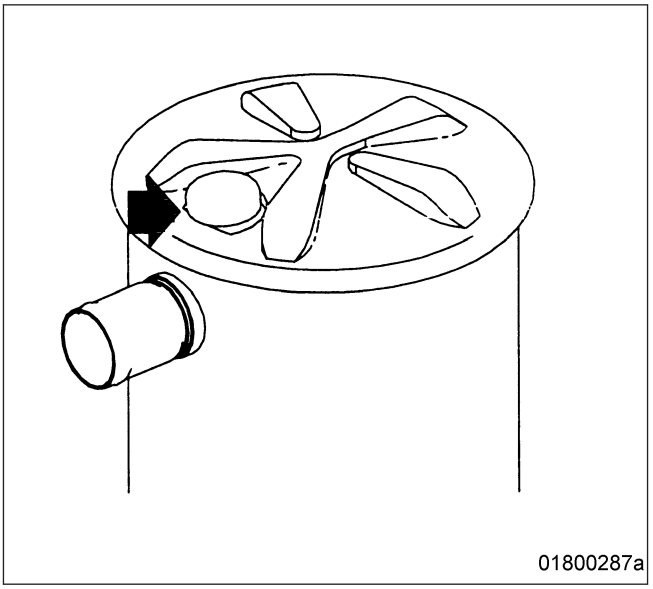
Preconditions

☑ Engine is running.

Checking oil separator

Note: A thin oil film is admissible.

1. Check oil separator for damage and excessive oil discharge (arrow).
2. Replace oil separator if it is defective (→ Page 119).



TIM-ID: 0000003511 - 005

7.3.2 Crankcase breather – Oil separator replacement, diaphragm check and replacement

Preconditions

☑ Engine shut down and starting disabled.

Special tools, Material, Spare parts

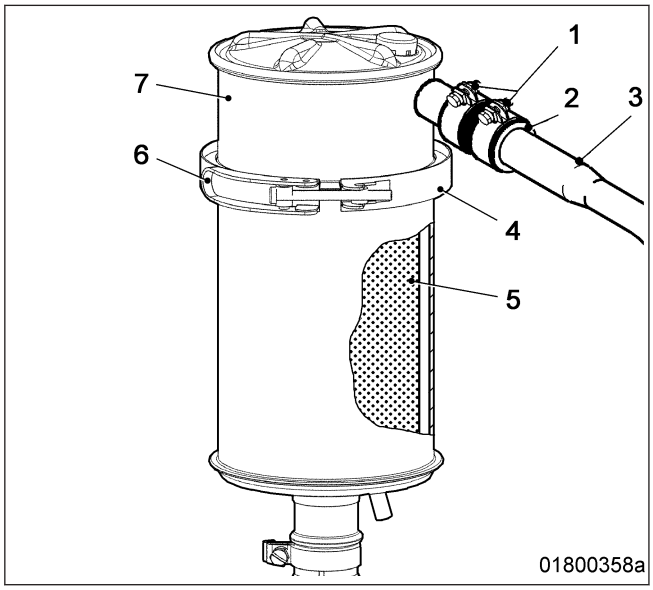
Designation / Use	Part No.	Qty.
Torque wrench, 6-50 Nm	F30027336	1
Ratchet adapter	F30027340	1
Engine oil		
Filter element	(→ Spare Parts Catalog)	
Diaphragm	(→ Spare Parts Catalog)	
Gasket	(→ Spare Parts Catalog)	

WARNING

Hot oil.
Oil can contain combustion residues which are harmful to health.
Risk of injury and poisoning!
- Wear protective clothing, gloves, and goggles / safety mask.
- Avoid contact with skin.
- Do not inhale oil vapor.

Replacing filter element on crankcase breather (variant A)

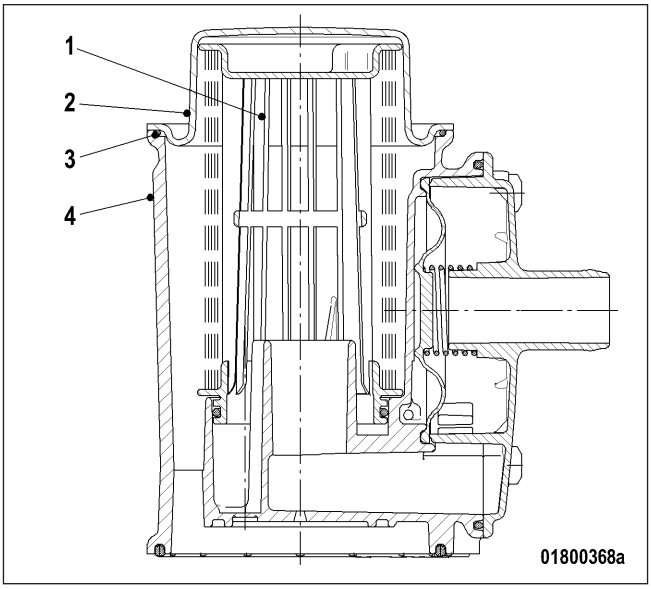
1. Release clamps (1).
2. Slide rubber sleeve (2) over pipe (3).
3. Release band clamp (4) with lever (6).
4. Remove cover (7).
5. Replace filter element (5).
6. Fit cover (7).
7. Tension band clamp (4) with lever (6).
8. Replace further oil filter elements in the same way.



TIM-ID: 0000003534 - 004

Crankcase breather – replacing filter element (variant B)

1. Remove cover (2) with O-ring (3).
2. Remove filter element (1) from housing (4).
3. Insert new filter element in housing (4).
4. Install cover (2) with new O-ring.



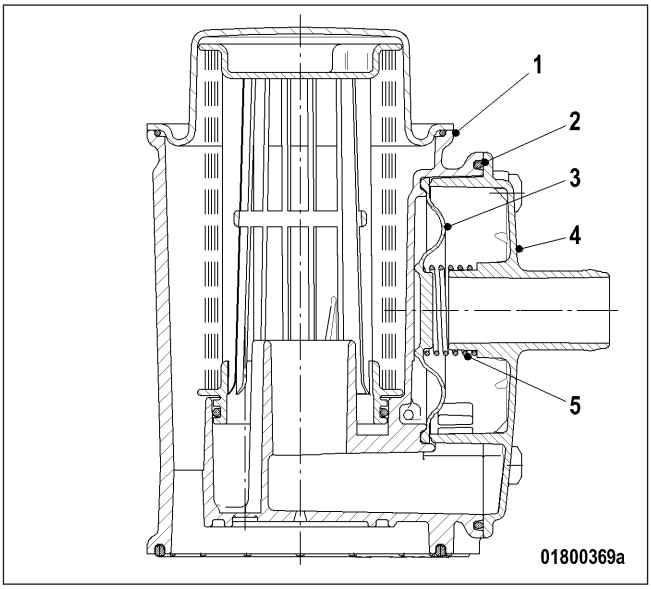
5. Use torque wrench to tighten the screws of cover (2) to the specified torque.

Name	Size	Type	Lubricant	Value/Standard
Screw		Tightening torque	(Engine oil)	6 Nm +2 Nm

6. Replace further oil separator elements in the same way.

Checking diaphragm (variant B)

1. Remove cover (4).
2. Remove spring (5), gasket (2) and diaphragm (3).
3. Check diaphragm (3) for damage, fit new diaphragm if used one is damaged.
4. Install diaphragm (3) on housing (1).
5. Install new gasket (2) and spring (5) together with cover (4).



6. Use torque wrench to tighten the screws of cover (4) to the specified torque.

Name	Size	Type	Lubricant	Value/Standard
Screw		Tightening torque	(Engine oil)	6 Nm +2 Nm

7. Check diaphragms in further oil separators in the same way.

TIM-ID: 0000003534 - 004

7.4 Valve Drive

7.4.1 Valve gear - Lubrication

Preconditions

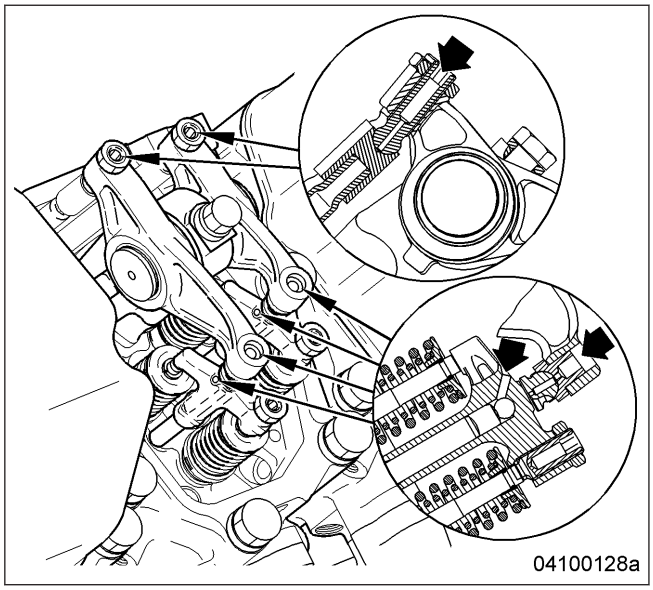
☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Engine oil		

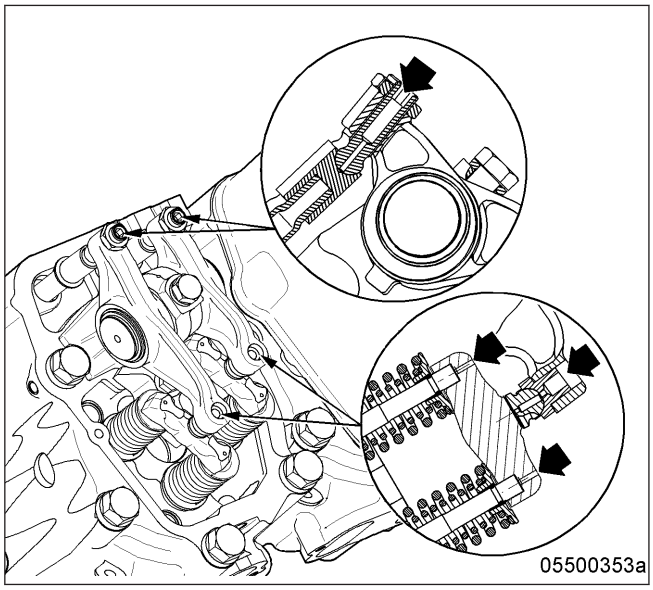
Lubricating valve gear (valve bridge with guide)

1. Remove cylinder head covers (→ Page 127).
2. Fill oil chambers of valve bridges with oil.
3. Fill oil chambers of rocker arms and adjusting screws with oil.
4. Install cylinder head covers (→ Page 127).



Lubricating valve gear (flying valve bridge)

1. Remove cylinder head covers (→ Page 127).
2. Fill oil chambers of rocker arms and adjusting screws with oil.
3. Install cylinder head covers (→ Page 127).



TIM-ID: 0000004338 - 003

7.4.2 Valve clearance – Check and adjustment

Preconditions

☑ Engine is stopped and starting disabled.

☑ Engine coolant temperature is max. 40 °C.

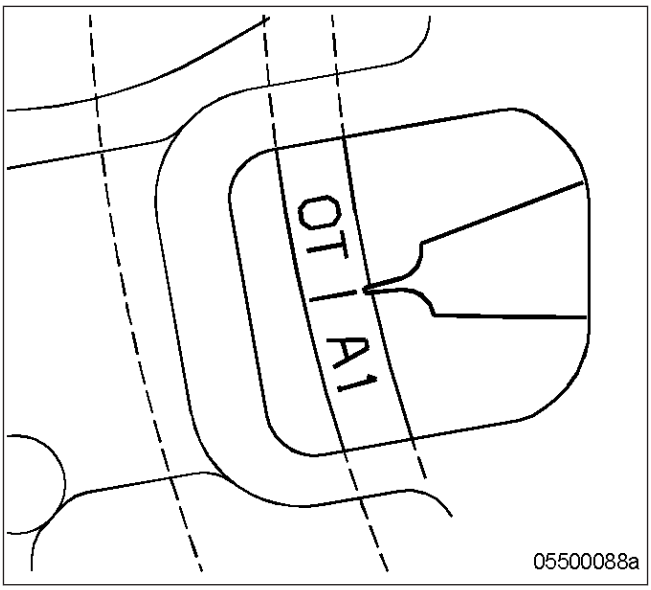
☑ Valves are closed.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Feeler gauge	Y20010128	1
Torque wrench 10-60 Nm	F30510423	1
Torque wrench 60-320 Nm	F30047446	1
Ring socket wrench	F30039518	1

Preparatory steps

1. Remove cylinder head cover (→ Page 127).
2. Install barring device (→ Page 112).
3. Rotate crankshaft with barring device in engine direction of rotation until "OT-A1" mark and pointer are aligned.



TIM-ID: 0000004352 - 004

Checking valve bridge balance

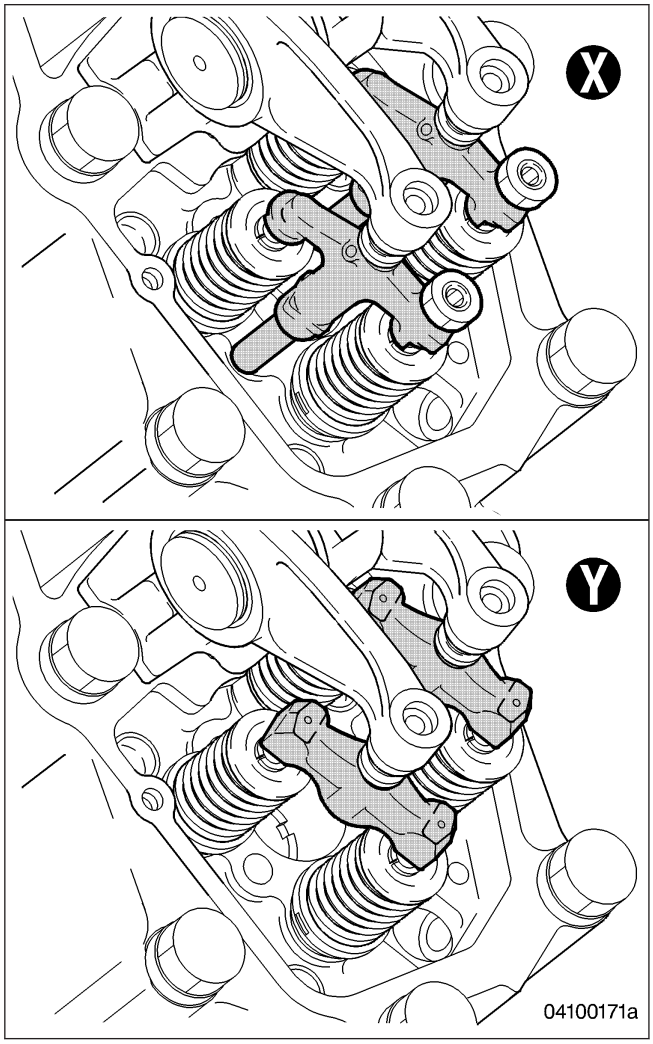
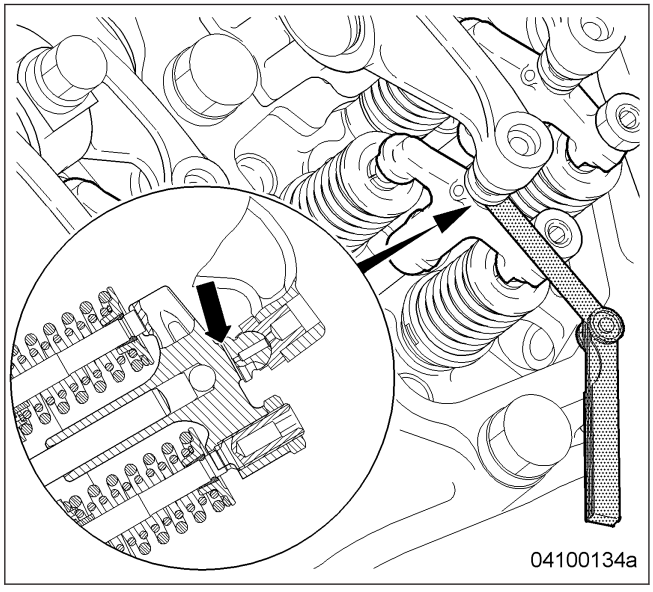


Fig.	Component
X	Valve bridge with guide
Y	Flying valve bridge

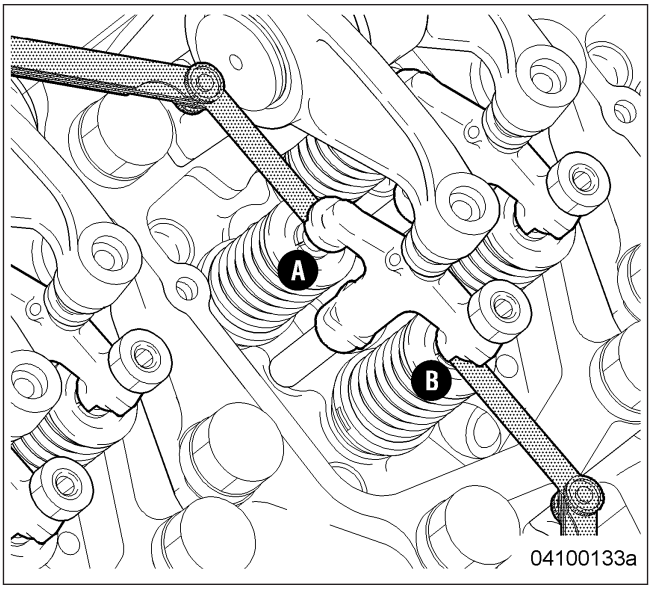
Note: Not applicable for engines with flying valve bridge.

1. Prior to adjusting valve clearance, check valve bridge balance on all valve bridges.
2. Use feeler gauge to determine distance between valve bridge and rocker arm.



TIM-ID: 0000004352 - 004

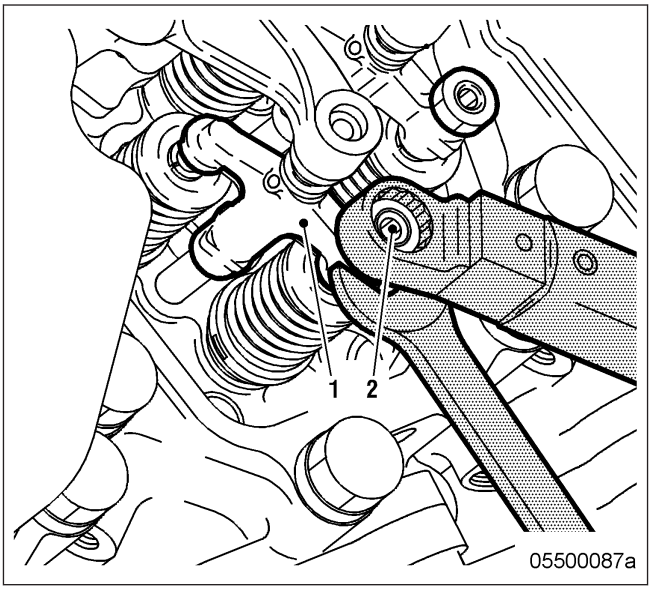
3. Insert feeler gauge with determined value between valve bridge and valve-stem end (A).
4. At the opposite valve-stem end (B), a feeler gauge thicker by 0.05 mm should not fit, otherwise adjust valve bridge balance.



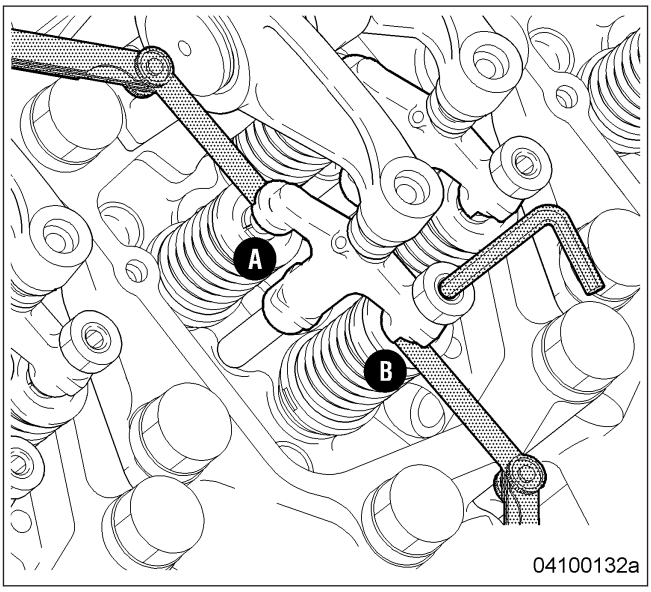
Adjusting valve bridge balance

Note: Not applicable for engines with flying valve bridge.

1. Hold valve bridge (1) firmly in position with open-end wrench and release locknut (2).

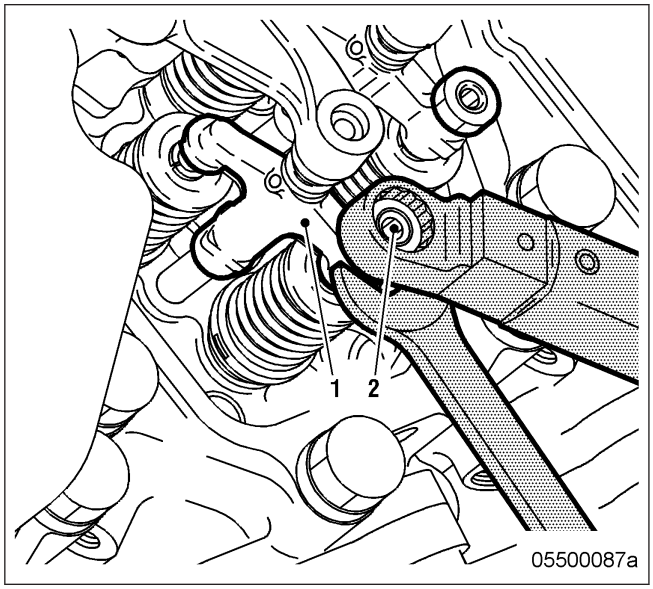


2. Use feeler gauge to determine distance between valve bridge and rocker arm.
3. Place one feeler gauge (of the determined value) each between valve bridge and the two valve-stem ends (A) and (B).
4. Turn adjusting screw such that both feeler gauges can just be pulled through.
5. Hold adjusting screw securely in position with Allen key and fit locknut by hand on valve bridge.
6. Replace or rectify adjusting screws which do not move freely.

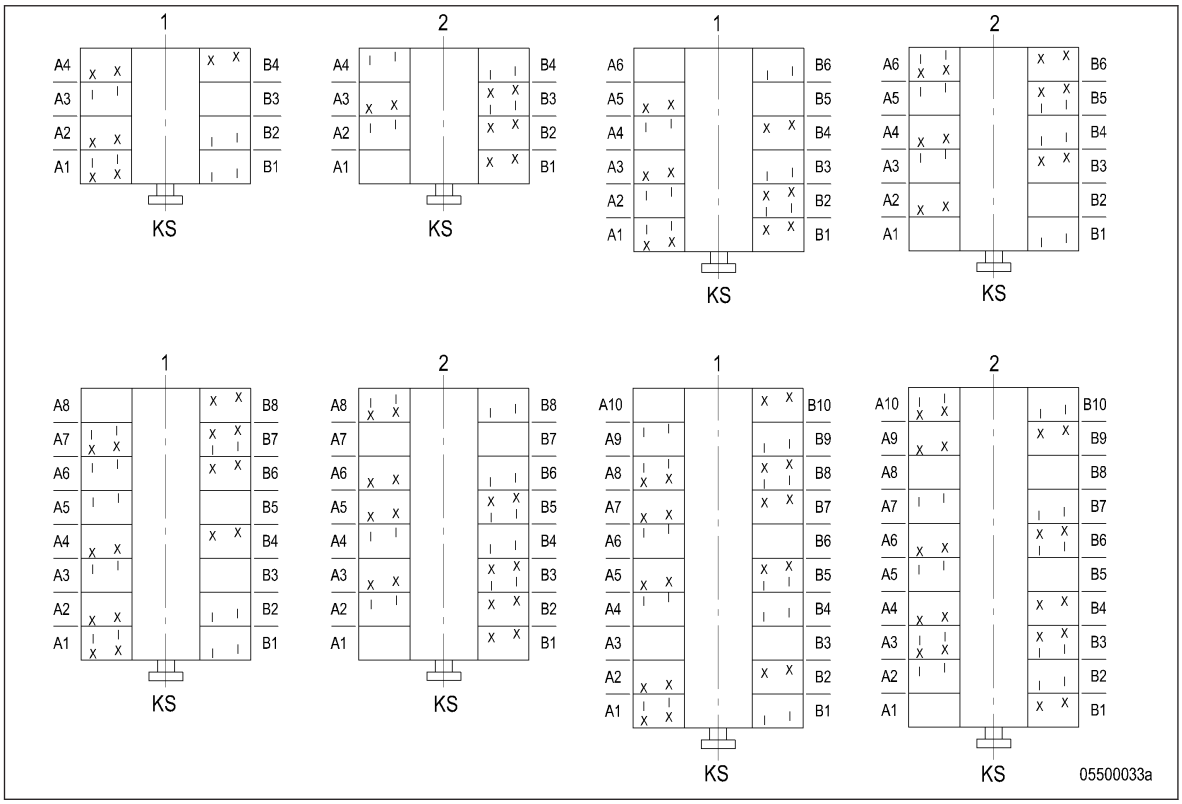


TIM-ID: 0000004352 - 004

7. Tighten locknut (2) to 35 Nm +5 Nm, holding valve bridge (1) in position with open-end wrench.
8. Recheck valve bridge balance.



Checking valve clearance at two crankshaft positions



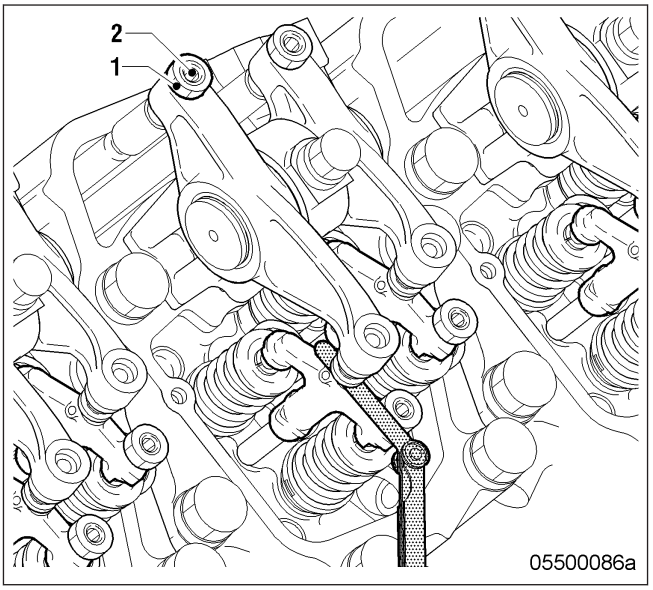
Item	Explanation
1	Cylinder A1 is in firing TDC
2	Cylinder A1 is in overlap TDC
I	Inlet valve
X	Exhaust valve

TIM-ID: 0000004352 - 004

1. Check TDC position of piston in cylinder A1:
   - If the rocker arms are unloaded on cylinder A1, the piston is in firing TDC.
   - If the rocker arms are under load on cylinder A1, the piston is in overlap TDC.
2. Check valve clearance with cold engine:
   - Inlet valves (long rocker arm) = 0.2 mm
   - Exhaust valves (short rocker arm) = 0.5 mm
3. Check all valve clearances in two crankshaft positions (firing TDC and overlap TDC of cylinder A1) as per diagram.
4. Use feeler gauge to determine the distance between valve bridge and rocker arm.
5. If the deviation from the set value exceeds 0.1 mm, adjust valve clearance.

Adjusting valve clearance

1. Release locknut (1).
2. Insert feeler gauge between valve bridge and rocker arm.
3. Turn adjusting screw (2) with Allen key until appropriate valve clearance is set.
4. Feeler gauge must just pass through the gap.
5. Tighten locknut (1) to 90 +9 Nm, holding adjusting screw (2) firmly.
6. Replace or rectify adjusting screws and/or locknuts which do not move freely.
7. Check valve clearance.



Final steps

1. Remove barring device (→ Page 112).
2. Install cylinder head cover (→ Page 127).

TIM-ID: 0000004352 - 004

7.4.3 Cylinder head cover – Removal and installation

Preconditions

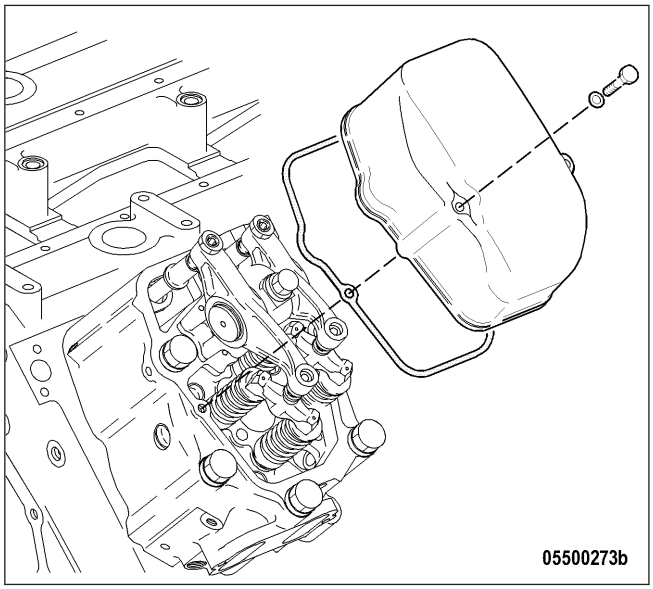
☑ Engine shut down and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Gasket	(→ Spare Parts Catalog)	

Removing cylinder head cover

1. Clean cylinder head covers prior to removal if they are heavily soiled.
2. Remove screws.
3. Remove cylinder head cover with gasket from cylinder head.



Installing cylinder head cover

1. Clean mating face.
2. Check condition of gasket, replace if necessary.
3. Place gasket and cylinder head cover on cylinder head.
4. Install cylinder head cover.

TIM-ID: 0000000923 - 005

7.5 Injection Pump / HP Pump

7.5.1 HP pump – Relief bore check

DANGER

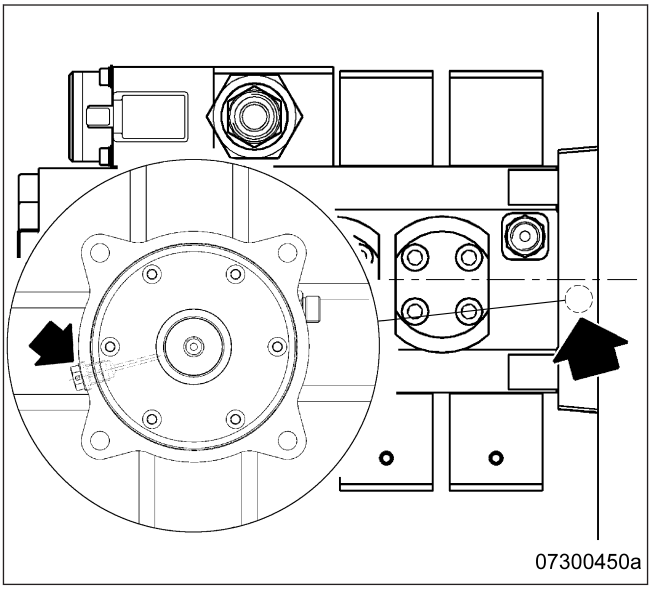
Unguarded rotating and moving engine components.
Risk of serious injury – danger to life!
- Take special care when working on a running engine.

WARNING

Engine noise above 85 dB (A).
Risk of damage to hearing!
- Wear ear protectors.

HP pump – Relief bore check

1. Check relief bore for oil and fuel discharge by visual inspection.
2. If relief bore is contaminated, stop the engine, disable engine start, and clean relief bore.
3. Note the following in case of fluid discharge:
   - Heavy discharge means continuous discharge of fluids (leakage). Contact Service.
   - Minor discharge of fluids up to 10 drops per day is normal (moistening) and not considered a leakage.



TIM-ID: 0000000924 - 005

7.6 Injection Valve / Injector

7.6.1 Injector – Replacement

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Injector	(→ Spare Parts Catalog)	

Replacing injector

▶ Remove injector and install new injector (→ Page 130).

TIM-ID: 0000000022 - 013

7.6.2 Injector – Removal and installation

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Installation and removal device for injector	F6790161	1
Milling cutter	F30452739	1
Slotted nut screwdriver	F30452578	1
Torque wrench, 0.5-5 Nm	0015384230	1
Torque wrench, 10-60 Nm	F30510423	1
Torque wrench, 60-320 Nm	F30047446	1
Assembly paste (Optimoly Paste White T)	40477	1
Grease (Kluthe Hakuform 30-10/Emulgier)	X00058060	1
Engine oil		

WARNING

Fuels are combustible.
Risk of fire and explosion!
- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

CAUTION

Removal of all injectors.
Damage to component!
- Ensure that the high-pressure fuel accumulator is secured on the engine through two HP lines.

CAUTION

Cable damage during operation.
Fire hazard!
- Twist cables when installing.
- Ensure that cables do not touch components.

Preparatory steps

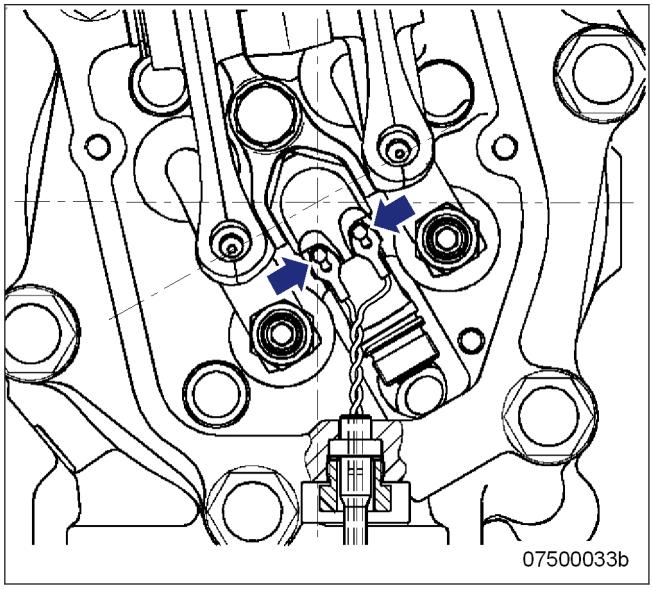
1. Shut off fuel supply to engine.
2. Remove cylinder head cover (→ Page 127).

TIM-ID: 0000000962 - 006

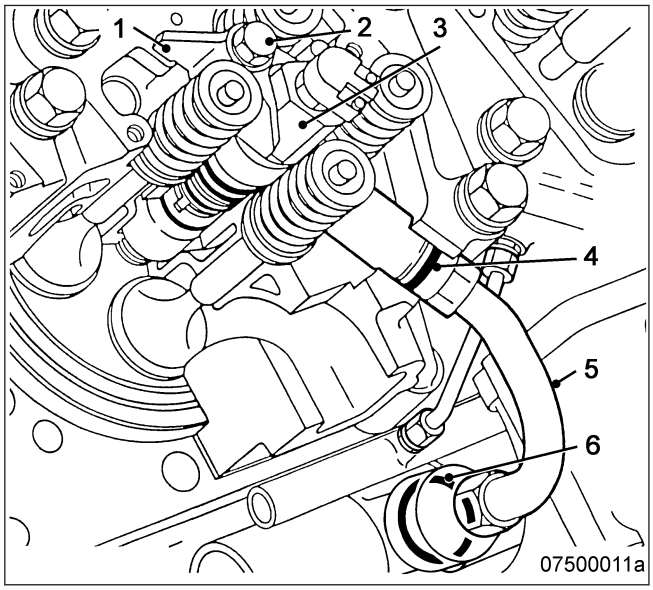
Removing injector

Note: Always replace the first and last injectors of one engine side first. Replace the inner injectors only after the installation of the outer injectors on this engine side is completed.

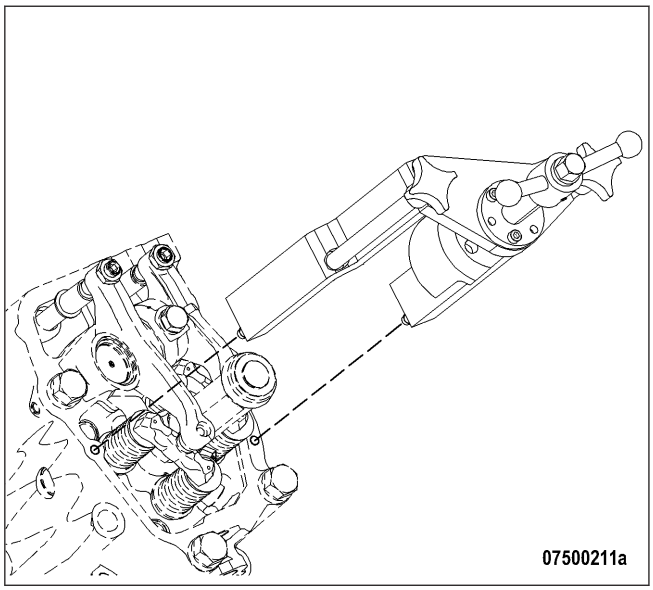
1. Undo cable terminal screws (arrow) on injector and remove cable terminals.



2. Remove screw (2) and take off hold-down clamp (1).
3. Remove high-pressure fuel line (5).

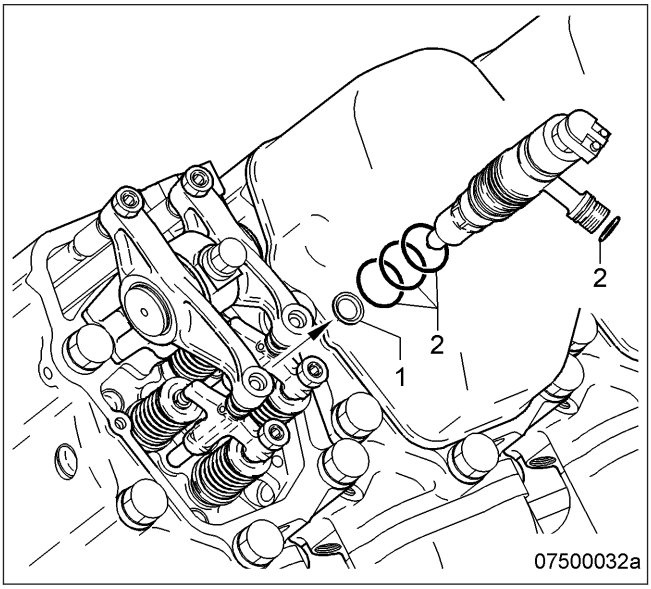


4. Install installation/removal device on cylinder head.
5. Remove injector with installation/removal device.
6. Remove installation/removal device.



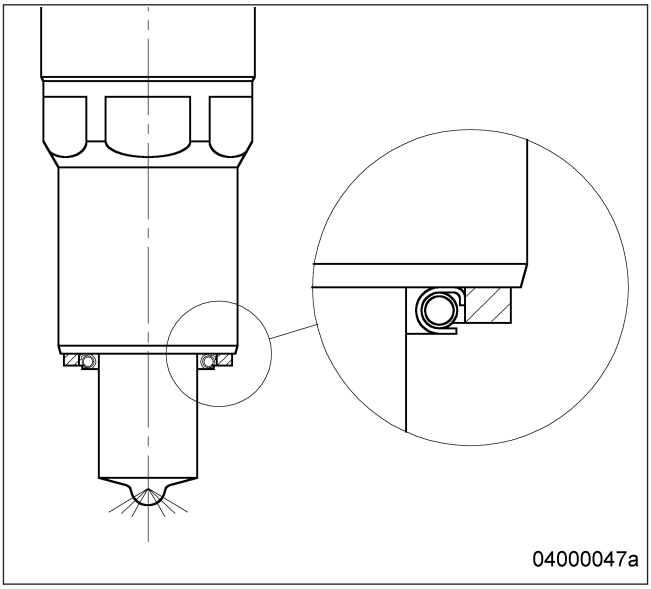
TIM-ID: 0000000952 - 006

7. Remove sealing ring (1) from injector or use a self-made wire hook to remove it from the cylinder head.
8. Remove O-rings (2) from injector.
9. Cover all connections and bores, or seal with suitable plugs.

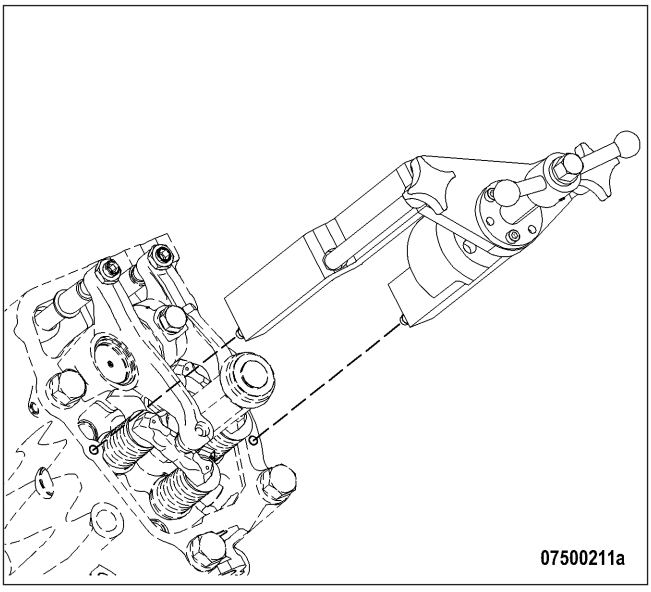


Installing injector

1. Remove all plugs before installing.
2. Coat nozzle retaining nut area of injector with assembly paste.
3. Fit new O-rings on injector and coat with grease.
4. Fit new sealing ring on injector with grease ensuring correct installation position of sealing ring.

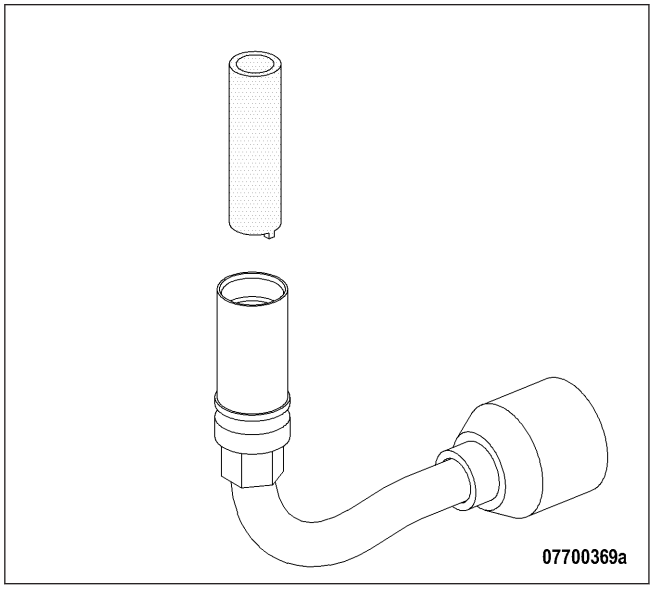


5. Clean sealing surface on cylinder head and protective sleeve with milling cutter.
6. Insert injector into cylinder head ensuring that the HP line connection is aligned correctly.
7. Press in injector with installation/removal device.
8. Remove installation/removal device.



TIM-ID: 0000000952 - 006

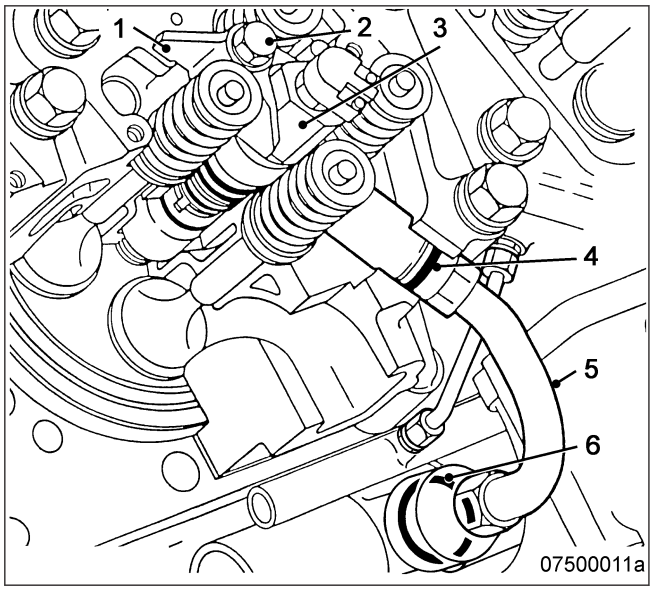
9. Use slotted screwdriver to check thrust ring at both line ends for secure seating.



10. Tighten loose thrust ring to the specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Thrust ring		Tightening torque		5 Nm to 10 Nm

11. Coat screw head mating face (2) and thread with engine oil.



12. Place hold-down clamp (1) in correct installation position. Tighten screw (2) with torque wrench to the specified initial tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Screw	M12	Preload torque	(Engine oil)	5 Nm to 10 Nm

13. Fit O-rings (4) and (6) on high-pressure fuel line (5) and coat with grease.
14. Tighten high-pressure fuel line (5) to the specified initial tightening torque.

Name	Size	Type	Lubricant	Value/Standard
HP line		Preload torque	(Engine oil)	5 Nm to 10 Nm

15. Tighten screw (2) to specified torque using a torque wrench.

Name	Size	Type	Lubricant	Value/Standard
Screw	M12	Tightening torque		100 Nm + 10 Nm

TIM-ID: 0000000952 - 006

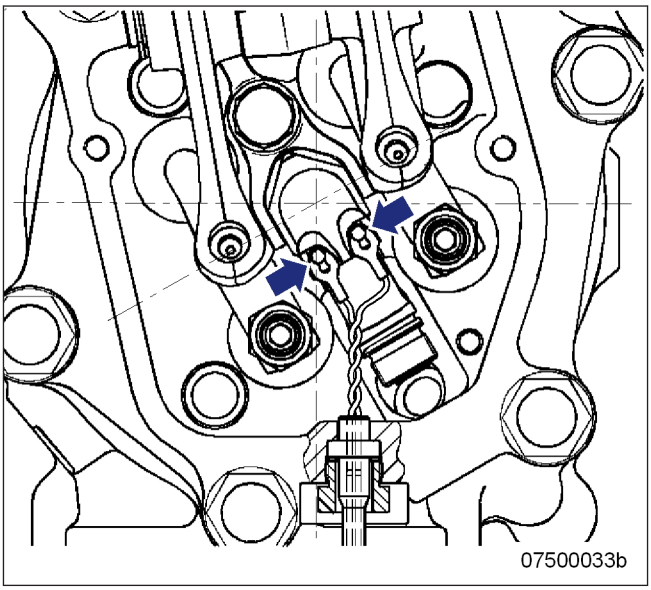
16. Tighten union nut of connecting piece (limiting valve) to specified torque using a torque wrench.

Name	Size	Type	Lubricant	Value/Standard
Union nut		Tightening torque		140 Nm + 10 Nm

17. Tighten union nut of connecting piece (injector) to specified torque using a torque wrench.

Name	Size	Type	Lubricant	Value/Standard
Union nut		Tightening torque		120 Nm +10 Nm

18. Twist cable several times.



19. Insert cable terminals (arrows) underneath screws on injector and tighten screws to specified torque using a torque wrench.

Name	Size	Type	Lubricant	Value/Standard
Screw		Tightening torque		1.5 Nm

Final steps

1. Install cylinder head cover (→ Page 127).
2. Open up fuel supply to engine.

TIM-ID: 0000000952 - 006

7.7 Fuel System

7.7.1 Fuel system – Venting and filling

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

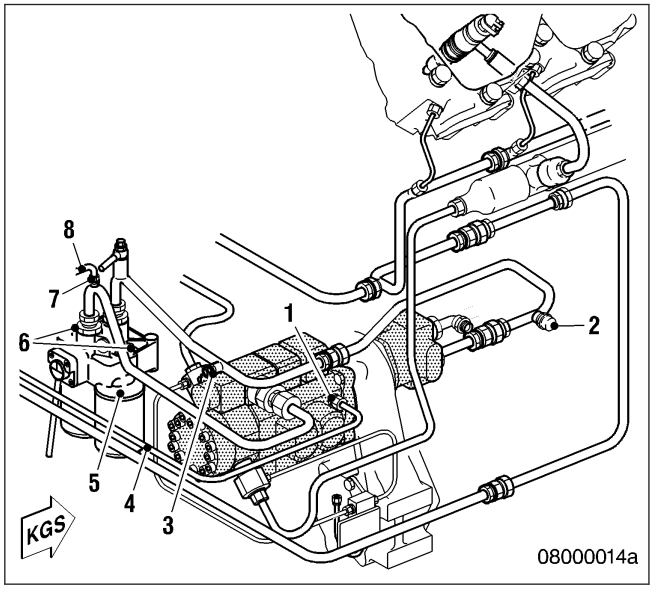
Designation / Use	Part No.	Qty.
Filling device	B80144852	1
Diesel fuel		

WARNING

Fuels are combustible.
Risk of fire and explosion!
- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

Venting and filling LP fuel system

1. Connect filling device to connection (2).
2. Open vent plugs (6) on filter (5).
3. Use hand pump to fill fuel system, providing pressure of min. 0.5 bar / max. 2.0 bar, until fuel emerges without bubbles at vent plugs (6).
4. Close vent plugs (6).
5. Remove filling device and seal connection (2).



TIM-ID: 0000004713 - 002

Venting and filling HP fuel system

1. Connect filling device to connection (3).
2. Remove flushing line (4) from HP pump (1).
3. Connect return hose of filling device to HP pump (1).
4. Unscrew vent line (8) from connection (7).
5. Seal connection (7) with sealing cone.

Note: During filling, the opening of the valves in the HP pump must be audible (whistling noise). To open the valves, minimum pressure of 9 bar must be provided.

6. Fill fuel system with hand pump, providing 9 bar minimum pressure.
7. If no whistling sound is audible, pump must be operated faster.
8. Filling is completed if:
   - Whistling noise is no more audible during pumping;
   - Bubble-free fuel emerges from the return hose of the filling device.
9. Disconnect return hose from filling device at HP pump (1).
10. Connect flushing line (4) to HP pump.
11. Remove sealing cone from connection (7).
12. Connect vent line (8) at connection (7).
13. Remove filling device from connection (3) and seal.

TIM-ID: 0000004713 - 002

7.8 Fuel Filter

7.8.1 Fuel filter – Replacement

Preconditions

☑ Engine shut down and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Oil filter wrench	F30379104	1
Diesel fuel		
Easy-change filter	(→ Spare Parts Catalog)	
Plastic ring	(→ Spare Parts Catalog)	

DANGER

Unguarded rotating and moving engine components.
Risk of serious injury – danger to life!
- Take special care when working on a running engine.

WARNING

Fuels are combustible.
Risk of fire and explosion!
- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

WARNING

Engine noise above 85 dB (A).
Risk of damage to hearing!
- Wear ear protectors.

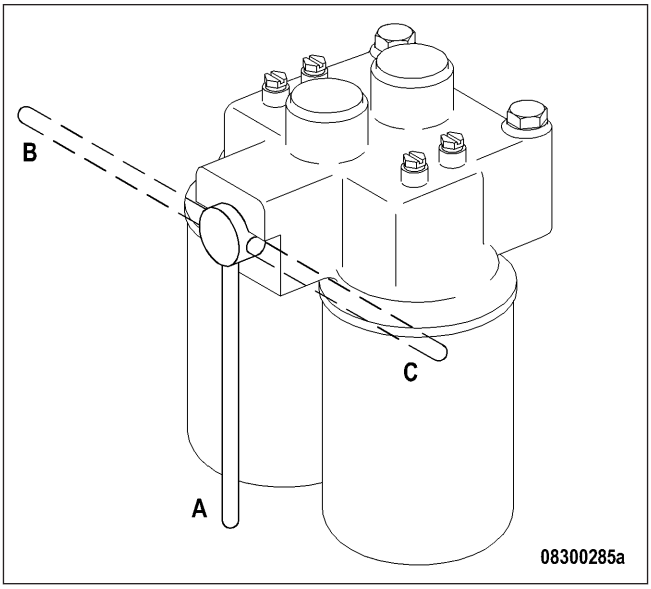
CAUTION

Damage to component.
Serious damage to plant!
- For filter replacement with the engine running, operate the engine at low engine load.
- The filter which is to be exchanged must be cut out for a brief period only.

TIM-ID: 0000004911 - 005

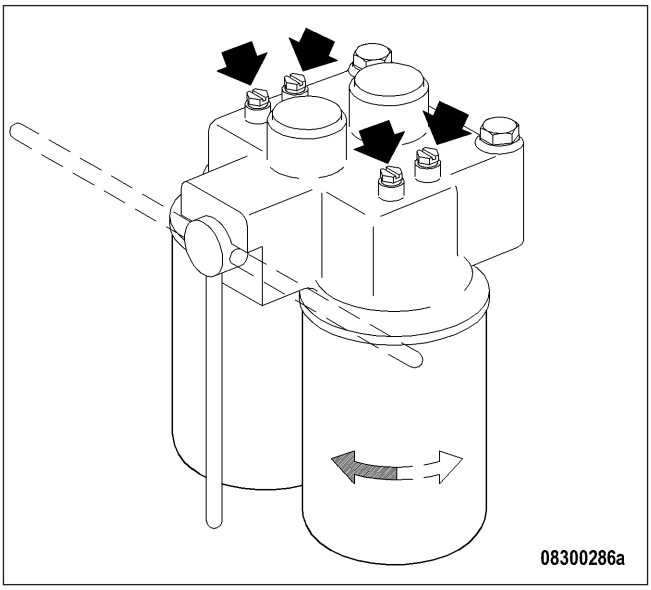
Replacing fuel filter with the engine stopped

1. Cut out the filter to be replaced.
   - A Both filters cut in (operating position)
   - B Left filter cut out
   - C Right filter cut out
2. Unscrew cut-out easy-change filter with oil filter wrench.
3. Clean sealing face on filter head.
4. Check sealing ring on new easy-change filter and moisten with fuel.
5. Fit SOLAS shield (→ Page 19).
6. Screw on easy-change filter and tighten by hand.
7. Set three-way cock to operating position for both filters (normal position).
8. Replace other fuel filters in the same way.
9. Vent fuel system (→ Page 135).



Replacing fuel filter with the engine running

1. Cut out the filter to be replaced.
2. Open threaded vent plugs at filter head of cut-out filter and ensure that fuel filter is not under pressure.
3. Close threaded vent plugs.
4. Unscrew cut-out easy-change filter with oil filter wrench.
5. Clean sealing face on filter head.
6. Check sealing ring on new easy-change filter and moisten with fuel.
7. Fit SOLAS shield (→ Page 19).
8. Screw on easy-change filter and tighten by hand.
9. Set three-way cock to operating position for both filters (normal position).
10. Replace other fuel filters in the same way.



TIM-ID: 0000004911 - 005

7.8.2 Fuel prefilter – Draining

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

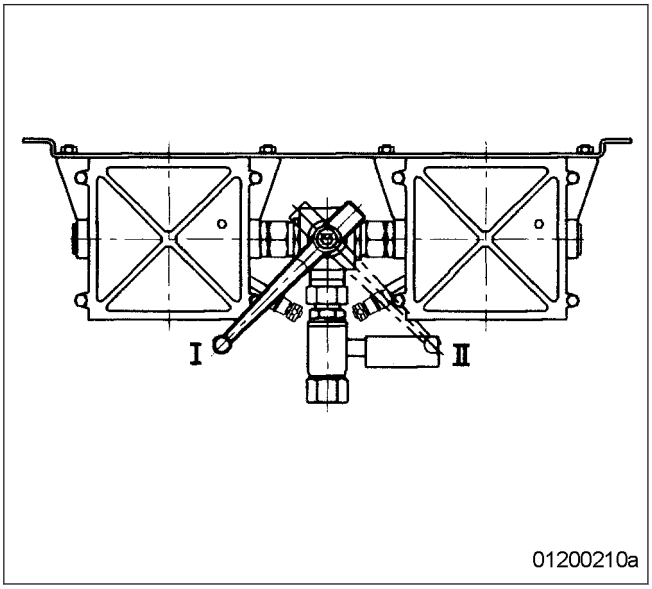
Designation / Use	Part No.	Qty.
Diesel fuel		
Gasket	(→ Spare Parts Catalog)	

WARNING

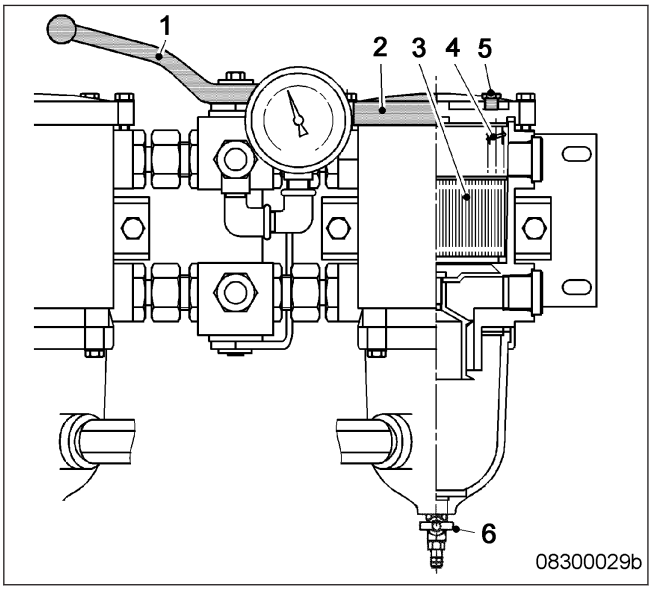
Fuels are combustible.
Risk of fire and explosion!
- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

Fuel prefilter – Draining

1. Cut out filter to be drained.
   - I Left filter cut in
   - II Right filter cut in



2. Open threaded vent plug (5) of filter to be drained.
3. Unlock drain valve (6) by pressing toggle and open it.
4. Drain water and contaminants from filter until pure fuel emerges.
5. Close drain valve (6).
6. Remove screws for cover and take off cover (2).
7. Fill filter housing with clean fuel.
8. Place new gasket in cover (2).
9. Fit cover with gasket and secure it with screws.
10. Cut in the cut-out filter again.
11. Close threaded vent plug (5) when fuel emerges.



TIM-ID: 0000004929 - 003

7.8.3 Fuel prefilter – Flushing

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Diesel fuel		
Gasket	(→ Spare Parts Catalog)	

DANGER

Unguarded rotating and moving engine components.
Risk of serious injury – danger to life!
- Take special care when working on a running engine.

WARNING

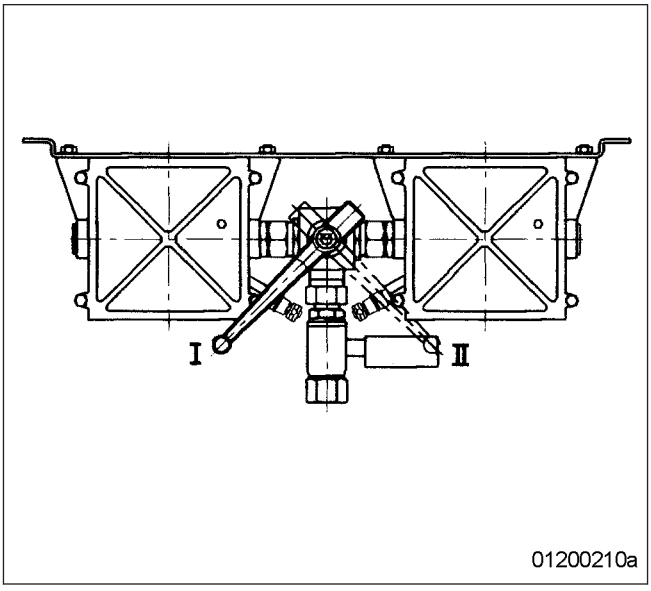
Fuels are combustible.
Risk of fire and explosion!
- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

WARNING

Engine noise above 85 dB (A).
Risk of damage to hearing!
- Wear ear protectors.

Flushing fuel prefilter

1. Cut out clogged filter.
   - I Left filter cut in
   - II Right filter cut in

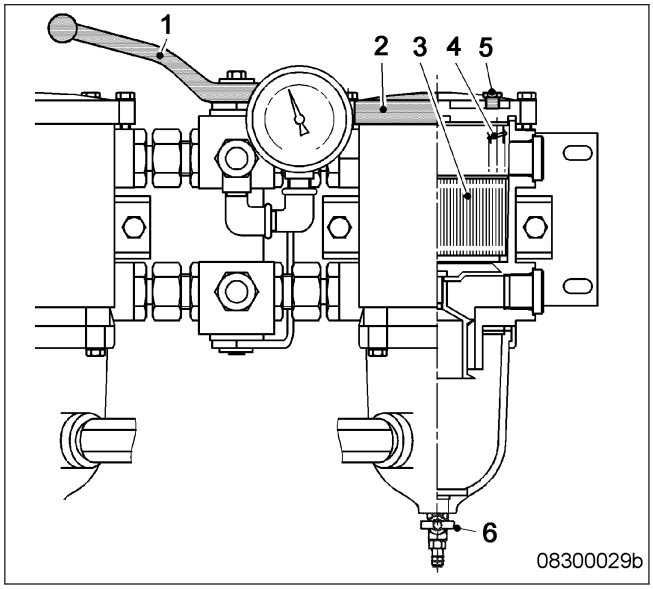


TIM-ID: 0000004937 - 014

2. Open threaded vent plug (5) of filter to be flushed.
3. Unlock drain valve (6) by pressing toggle, open it and drain fuel.

Result: Fuel flows from filtered side back to the unfiltered side, flushing the filter deposits downwards out of the filter.

4. Close threaded vent plug (5) and drain valve (6).



Fuel prefilter, topping up with fuel

1. Stop engine (→ Page 100) and disable engine start.
2. Remove screws for cover and take off cover (2).
3. Fill filter housing with clean fuel.
4. Place new gasket in cover (2).
5. Fit cover with gasket and secure it with screws.
6. Check differential pressure (→ Page 142).

Result: If flushing did not lead to an improvement of the differential pressure, replace filter element of fuel prefilter (→ Page 143).

TIM-ID: 0000004937 - 014

7.8.4 Fuel prefilter – Differential pressure gauge check and adjustment

DANGER

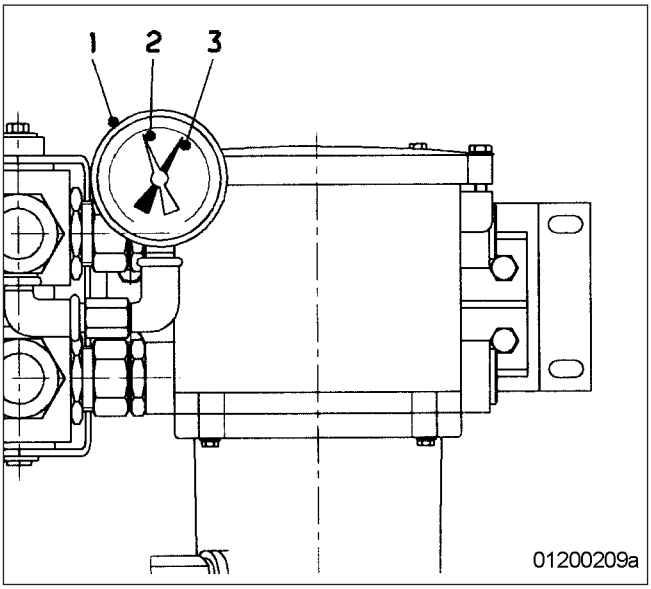
Unguarded rotating and moving engine components.
Risk of serious injury – danger to life!
- Take special care when working on a running engine.

WARNING

Engine noise above 85 dB (A).
Risk of damage to hearing!
- Wear ear protectors.

Adjusting differential pressure gauge

1. When installing the new filter element: align adjustable pointer (2) with pressure-indicating pointer (3) of pressure gauge (1).
2. Check differential pressure.



Checking differential pressure of fuel prefilter

1. With the engine running at full load or rated power, read off pressure at gauge (1).
2. If differential pressure as indicated between position of adjustable pointer (2) and pressure-indicating pointer (3) of pressure gauge is ≥ 0.3 bar, flush filter element of the cut-in filter (→ Page 140).

TIM-ID: 0000004925 - 004

7.8.5 Fuel prefilter – Filter element replacement

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

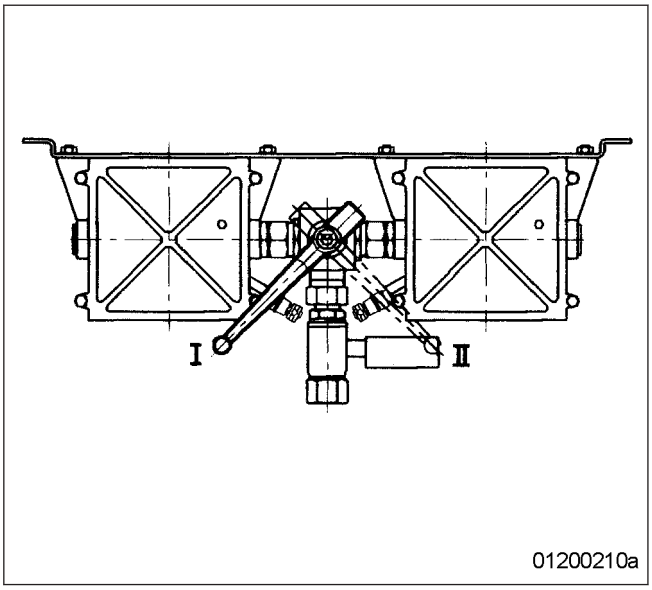
Designation / Use	Part No.	Qty.
Diesel fuel		
Filter element	(→ Spare Parts Catalog)	
Gasket	(→ Spare Parts Catalog)	

WARNING

Fuels are combustible.
Risk of fire and explosion!
- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

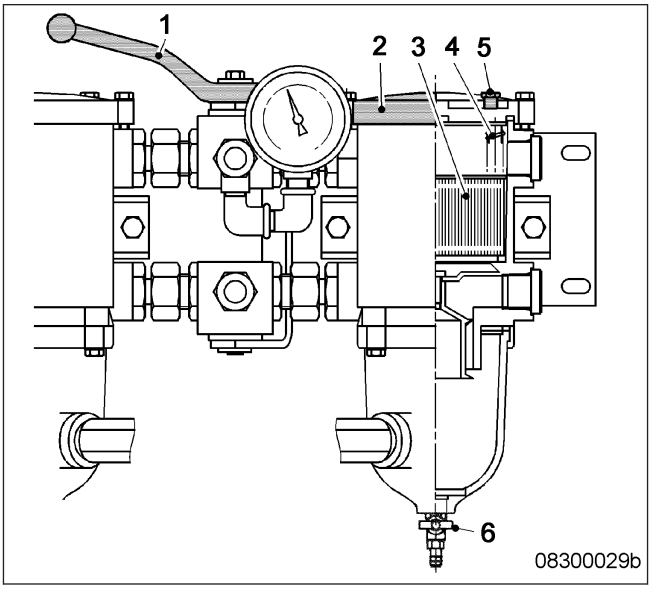
Replacing filter element

1. Cut out filter to be drained.
   - I Left filter cut in
   - II Right filter cut in



TIM-ID: 0000004944 - 003

2. Open threaded vent plug (5) of contaminated filter.
3. Unlock drain valve (6) by pressing toggle and open it.
4. Drain water and dirt from filter.
5. Close drain valve (6).
6. Remove screws securing the cover and take off cover (2).
7. Remove spring housing (4) and filter element (3).
8. Insert new filter element (3) and spring housing (4).
9. Fill filter housing with clean fuel.
10. Place new gasket in cover (2).
11. Fit cover with gasket and secure it with screws.
12. Cut in the cut-out filter again.
13. Close threaded vent plug (5) when fuel emerges.
14. Adjust the differential pressure gauge (→ Page 142).



TIM-ID: 0000004944 - 003

7.9 Exhaust Turbocharger

7.9.1 Compressor wheel – Cleaning

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Cold cleaner	X00056750	1

WARNING

Compressed air
Risk of injury!
- Do not direct compressed-air jet at persons.
- Wear protective goggles / safety mask and ear protectors.

WARNING

Chemical substances.
Risk of irritation and chemical burns!
- Always obey manufacturer's instructions for use!

CAUTION

Incorrect installation of components and lines.
Damage to component!
- Ensure that components/lines are installed so that they are never under tension or strain.
- Ensure correct installation position of components.

CAUTION

Unsuitable cleaning tool.
Damage to component!
- Observe manufacturer's instructions.
- Use appropriate cleaning tool.

Preparatory steps

1. Drain engine coolant.(→ Page 166)
2. Remove air filter.(→ Page 149)
3. Remove exhaust system after exhaust turbocharger.
4. Remove exhaust flap with actuators.
5. Remove air intake.

Compressor wheel – Cleaning

Note: Do not use wire brush, scraper or similar tools for cleaning!

1. Clean compressor housing with paint brush or smooth brush.
2. Clean compressor wheel and bearing housing with cold cleaner.
3. Thoroughly blow out all parts with compressed air to remove cold cleaner.

TIM-ID: 0000034852 - 001

Final steps

1. Install air intake.
2. Install exhaust flap with actuators.
3. Install exhaust system after exhaust turbocharger.
4. Install air filter.(→ Page 149)
5. Fill with engine coolant.(→ Page 167)

TIM-ID: 0000034852 - 001

7.10 Charge-Air Cooling

7.10.1 Intercooler – Checking condensate drain line for coolant discharge and obstruction

DANGER

Unguarded rotating and moving engine components.
Risk of serious injury – danger to life!
- Take special care when working on a running engine.

WARNING

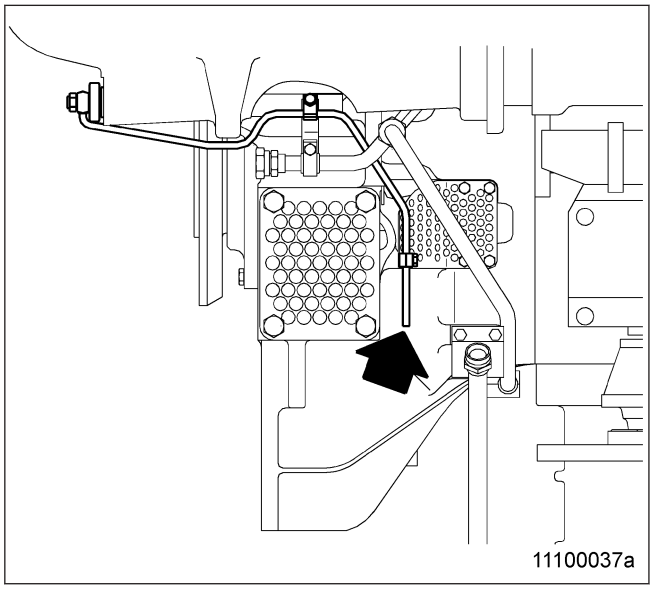
Engine noise above 85 dB (A).
Risk of damage to hearing!
- Wear ear protectors.

WARNING

Compressed air
Risk of injury!
- Do not direct compressed-air jet at persons.
- Wear protective goggles / safety mask and ear protectors.

Intercooler – Checking condensate drain line for coolant discharge and obstruction

1. With the engine running, verify that air emerges from the condensate drain line at driving end, left and right engine side. If no air escapes:
2. Clean condensate drain line(s) and blow out with compressed air.
3. Replace clogged condensate drain line(s) by new one(s).
4. Install condensate drain line(s).
5. If a large amount of coolant is continuously discharged, the intercooler is leaking. Contact Service.



Emergency measures prior to engine start with a leaking intercooler

1. Remove injectors (→ Page 130).
2. Bar engine manually (→ Page 112).
3. Bar engine with starting system to blow out cylinder chambers (→ Page 113).
4. Install injectors (→ Page 130).

TIM-ID: 0000005338 - 003

7.11 Air Filter

7.11.1 Air filter – Replacement

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Air filter	(→ Spare Parts Catalog)	

Replacing the air filter

1. Remove old air filter and install new air filter (→ Page 149).
2. Reset signal ring of contamination indicator (→ Page 152).

TIM-ID: 0000005447 - 009

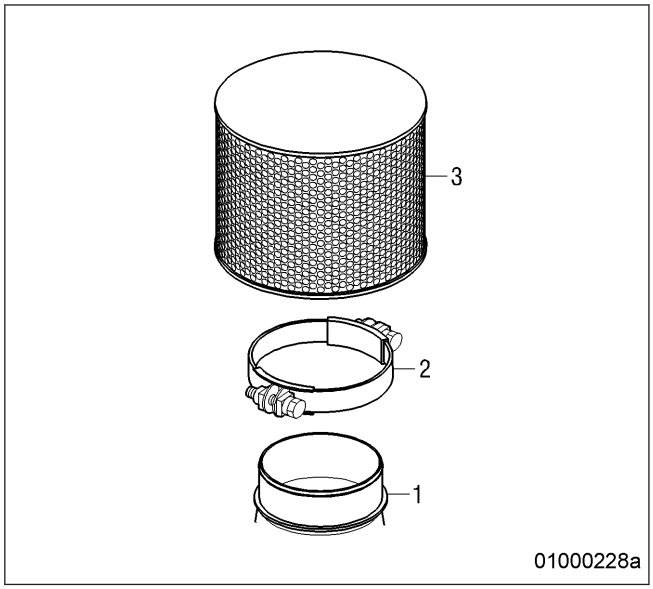
7.11.2 Air filter – Removal and installation

Preconditions

☑ Engine is stopped and starting disabled.

Air filter – Removal and installation

1. Release clamp (2).
2. Remove air filter (3) and clamp (2) from flange of intake housing (1).
3. Verify that there are no objects in the flange of the intake housing (1) and clean it.
4. Place new air filter (3) with clamp (2) onto intake housing (1).
5. Tighten clamp (2).



TIM-ID: 0000000904 - 009

7.12 Starting Equipment

7.12.1 Starter – Condition check

Preconditions

☑ Engine is stopped and starting disabled.

Starter – Condition check

1. Check securing screws and pressure hose of starter for secure seating and tighten if required.
2. Check wiring (→ Page 185).

TIM-ID: 0000019523 - 002

7.12.2 Air starter – Manual operation

DANGER

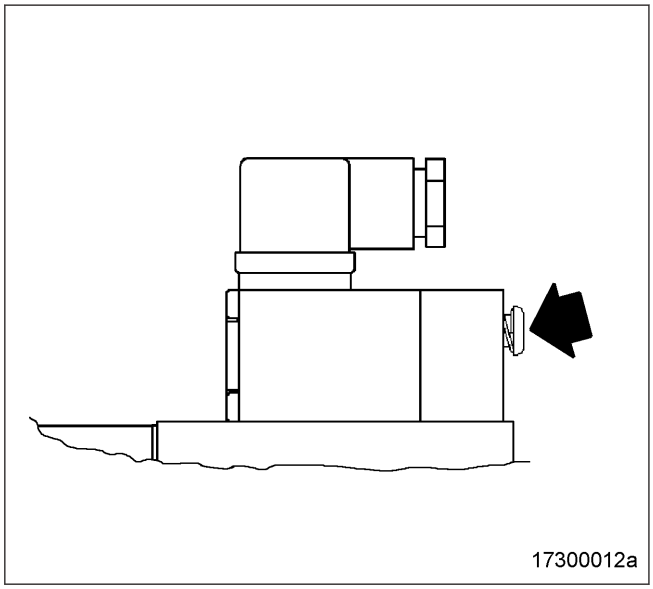
Unguarded rotating and moving engine components.
Risk of serious injury – danger to life!
- Before barring or starting the engine, make sure that nobody is in the danger zone.

WARNING

Engine noise above 85 dB (A).
Risk of damage to hearing!
- Wear ear protectors.

Air starter – Manual operation

1. Press pushbutton for manual start and hold it.
2. Allow compressed air to enter the air starter, until the engine fires evenly.
3. Release pushbutton.



TIM-ID: 0000006076 - 003

7.13 Air Intake

7.13.1 Contamination indicator – Signal ring position check

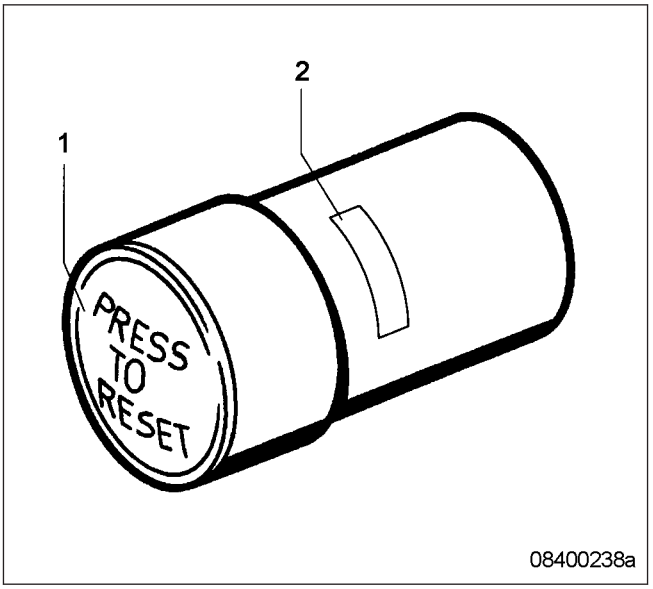
Preconditions

☑ Engine is stopped and starting disabled.

Checking signal ring position

1. If the signal ring is completely visible in the control window (2), replace air filter (→ Page 148).
2. After installation of new filter, press reset button (1).

Result: Engaged piston with signal ring moves back to initial position.



TIM-ID: 0000005484 - 006

7.13.2 Air flap – Check for ease of movement

Preconditions

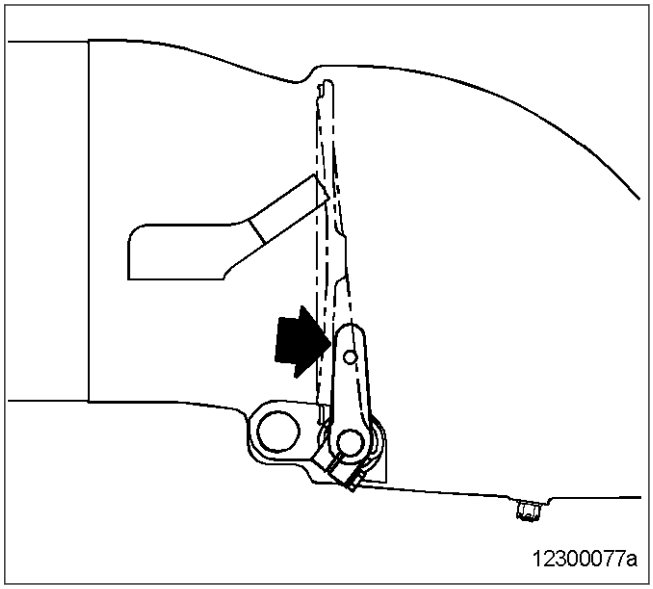
☑ Engine is stopped and starting disabled.

Checking air flap for easy movement

1. Actuate lever several times to check ease of movement.

Result: The spring must push back the air flap.

2. If spring does not return air flap to initial position, contact Service.



TIM-ID: 0000005490 - 003

7.13.3 Air pipework from air filter to ETC – Check

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Air hose	0229979482	2

Checking air pipework from air filter to ETC

Item	Findings	Measure
Visually check outer layer of air hose.	• Damage • Deformation • Cracks • Cuts • Brittleness • Scuffing visible	Replace
Check clamp.	Damaged	Replace

TIM-ID: 0000034354 - 001

7.14 Lube Oil System, Lube Oil Circuit

7.14.1 Engine oil level – Check

Preconditions

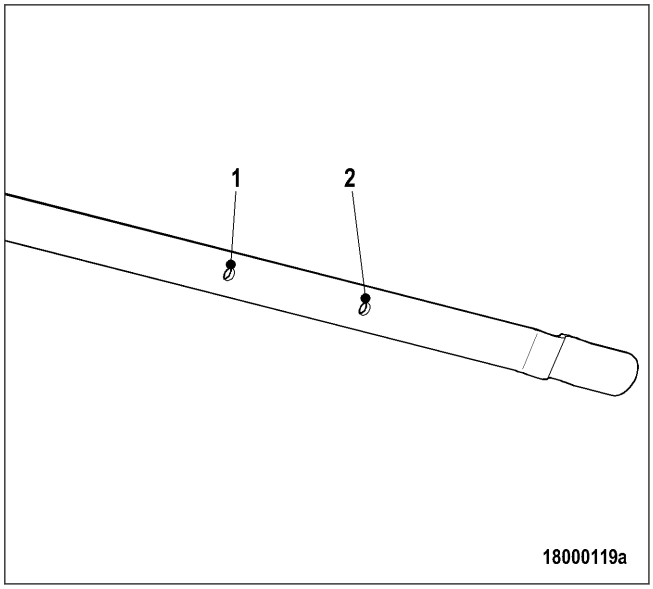
☑ Engine shut down and starting disabled.

Checking oil level prior to engine start

1. Withdraw oil dipstick from guide tube and wipe it.
2. Insert oil dipstick into guide tube up to stop, withdraw after approx. 10 seconds and check oil level.

Note: After extended standstill, the oil level may exceed the mark (1) by up to 2 cm. This can be caused by oil flowing from e.g. oil filter or heat exchanger back to the oil pan.

3. The oil level must reach mark (1) or exceed mark (1) by up to 2 cm.
4. Top up with oil to mark (1) as necessary (→ Page 156).
5. Insert oil dipstick into guide tube up to the stop.



Checking oil level after the engine is stopped

1. 5 minutes after stopping the engine, remove oil dipstick from the guide tube and wipe it.
2. Insert oil dipstick into guide tube up to stop, withdraw after approx. 10 seconds and check oil level.
3. Oil level must be between marks (1) and (2).
4. Top up with oil to mark (1) as necessary (→ Page 156).
5. Insert oil dipstick into guide tube up to the stop.

TIM-ID: 0000000931 - 009

7.14.2 Engine oil – Change

Preconditions

☑ Engine is stopped and starting disabled.

☑ Engine is at operating temperature.

☑ MTU Fluids and Lubricants Specifications (A001061/..) are available.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Torque wrench, 40-200 Nm	F30027337	1
Ratchet adapter	F30027341	1
Engine oil		
Sealing ring	(→ Spare Parts Catalog)	

WARNING

Hot oil.
Oil can contain combustion residues which are harmful to health.
Risk of injury and poisoning!
- Wear protective clothing, gloves, and goggles / safety mask.
- Avoid contact with skin.
- Do not inhale oil vapor.

Oil change without semirotary hand pump: Draining engine oil at drain plug(s) on oil pan

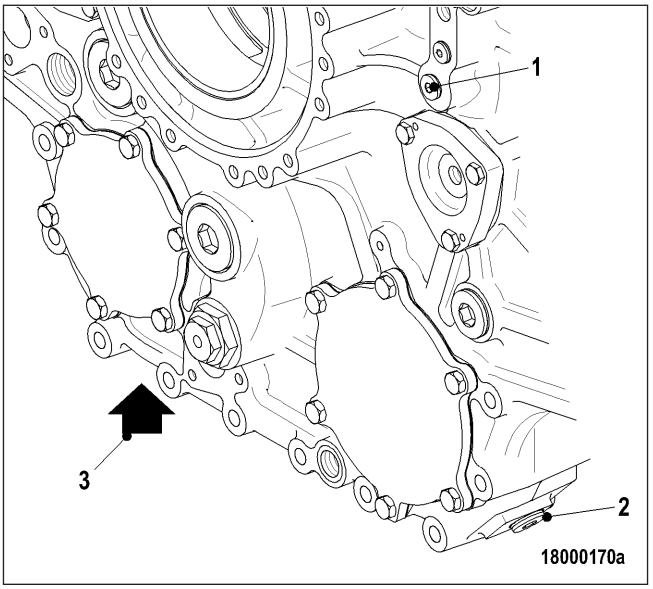
1. Provide a suitable container in which to collect the engine oil.
2. Remove drain plug(s) and drain engine oil.
3. Install drain plug(s) with new sealing ring.

Oil change with semirotary hand pump: Engine oil extraction

1. Provide a suitable container in which to collect the engine oil.
2. Extract all engine oil from oil pan using the semirotary hand pump.

Draining residual oil from equipment carrier (only with unscheduled engine oil change)

1. Provide a suitable container in which to collect the engine oil.
2. Remove drain plug (1) and drain engine oil from engine oil heat exchanger and from engine oil filter.
3. Remove drain plugs (2) and (3) and drain engine oil.
4. Replace engine oil filter (→ Page 159).
5. Install drain plug(s) with new sealing ring.



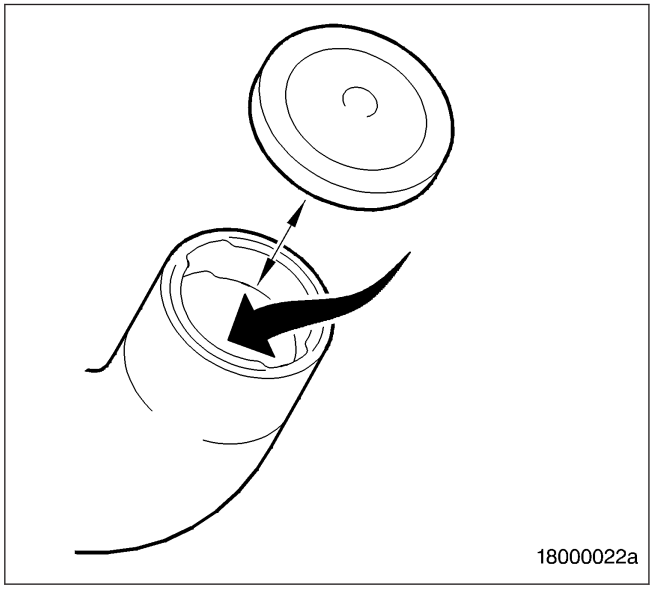
TIM-ID: 0000034455 - 001

6. Tighten drain plugs (2) and (3) with torque wrench to the specified torque.

Name	Size	Type	Lubricant	Value/Standard
Screw	M26 x 1.5	Tightening torque	(Engine oil)	100 Nm +10 Nm

Filling with new engine oil

1. Open cap on filler neck.
2. Pour in engine oil at filler neck up to “max.” mark on oil dipstick.
3. Close cap on filler neck.
4. Check engine oil level (→ Page 155).
5. After oil change and oil filter replacement, bar engine with starting system (→ Page 113).



TIM-ID: 0000034455 - 001

7.14.3 Engine oil – Sample extraction and analysis

Preconditions

☑ MTU Fluids and Lubricants Specifications (A001061/..) are available.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
MTU test kit	5605892099/00	1

DANGER

Unguarded rotating and moving engine components.
Risk of serious injury – danger to life!
- Take special care when working on a running engine.

WARNING

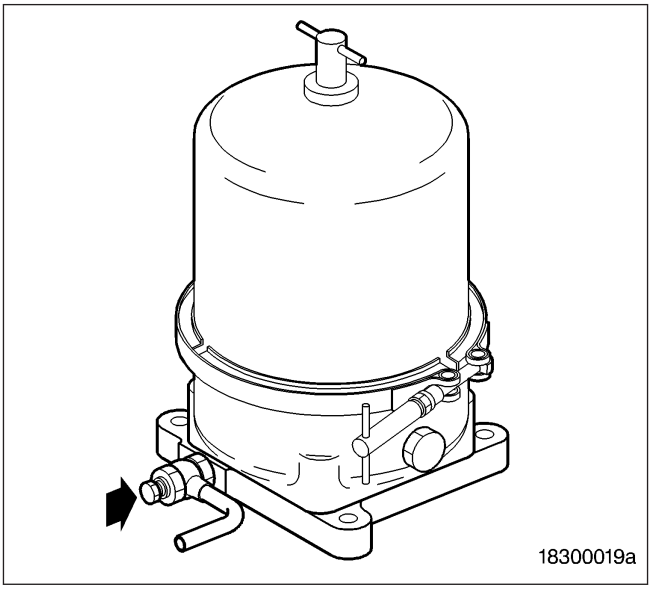
Hot oil.
Oil can contain combustion residues which are harmful to health.
Risk of injury and poisoning!
- Wear protective clothing, gloves, and goggles / safety mask.
- Avoid contact with skin.
- Do not inhale oil vapor.

WARNING

Engine noise above 85 dB (A).
Risk of damage to hearing!
- Wear ear protectors.

Engine oil sample extraction and analysis

1. With the engine running at operating temperature, open screw on flange of centrifugal oil filter by 1 to 2 rotations.
2. Drain approx. 2 liters engine oil to flush out the oil sludge.
3. Drain approx. 1 liter engine oil into a clean container.
4. Close screw.
5. Using the equipment and chemicals of the MTU test kit, examine oil for:
   - Dispersing capacity (spot test);
   - Water content;
   - Fuel dilution.



TIM-ID: 0000000956 - 003

7.15 Oil Filtration / Cooling

7.15.1 Engine oil filter – Replacement

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Oil filter wrench	F30379104	1
Engine oil		
Oil filter	(→ Spare Parts Catalog)	

DANGER

Unguarded rotating and moving engine components.
Risk of serious injury – danger to life!
- Take special care when working on a running engine.

WARNING

Engine noise above 85 dB (A).
Risk of damage to hearing!
- Wear ear protectors.

WARNING

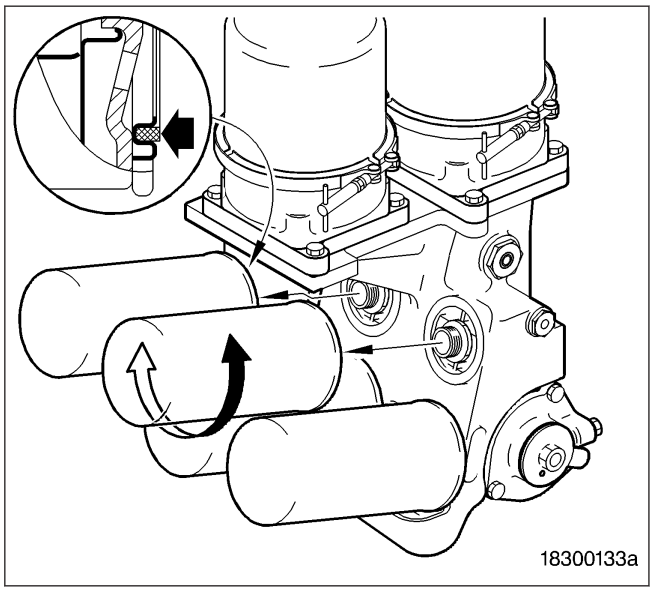
Hot oil.
Oil can contain combustion residues which are harmful to health.
Risk of injury and poisoning!
- Wear protective clothing, gloves, and goggles / safety mask.
- Avoid contact with skin.
- Do not inhale oil vapor.

CAUTION

Damage to component.
Serious damage to plant!
- For filter replacement with the engine running, operate the engine at low engine load.
- The filter which is to be exchanged must be cut out for a brief period only.

Oil filter replacement with the engine stopped

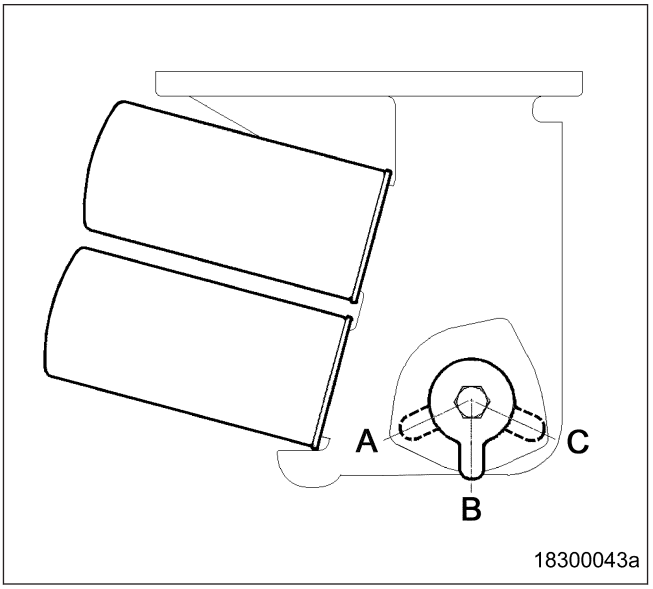
1. Stop engine (→ Page 100) and disable engine start.
2. Unscrew oil filter with oil filter wrench.
3. Clean sealing face on connecting piece.
4. Check condition of the new sealing ring and coat it with oil.
5. Fit SOLAS shield (→ Page 19).
6. Screw on and tighten new engine oil filter by hand.
7. Replace other oil filters in the same way.
8. After each oil change and filter replacement, bar engine with starting system (→ Page 113).
9. Check oil level (→ Page 155).



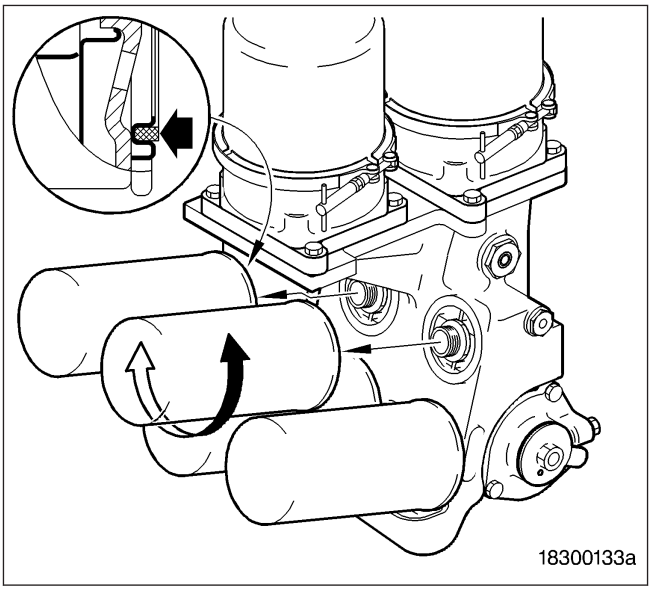
TIM-ID: 0000034458 - 001

Oil filter replacement with the engine running

1. To cut out the filter to be replaced, set the three-way cock to the corresponding position.
   - Position A: Lower filters cut out
   - Position B: Both filters cut in (normal position)
   - Position C: Upper filters cut out.



2. Unscrew oil filter with oil filter wrench.
3. Clean sealing face on connecting piece.
4. Check condition of the new sealing ring and coat it with oil.
5. Fit SOLAS shield (→ Page 19).
6. Screw on and tighten new engine oil filter by hand.
7. Replace other oil filters in the same way.
8. Check oil level (→ Page 155).



TIM-ID: 0000034458 - 001

7.15.2 Centrifugal oil filter – Cleaning and filter sleeve replacement

Preconditions

☑ Engine shut down and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Filter wrench	F30379104	1
Torque wrench, 6-50 Nm	F30027336	1
Ratchet adapter	F30027339	1
Cold cleaner (Hakutex 60)	50602	1
Grease (Kluthe Hakuform 30-10/emulsifier)	X00029933	1
Filter sleeve	(→ Spare Parts Catalog)	
Sealing ring	(→ Spare Parts Catalog)	
Sealing ring	(→ Spare Parts Catalog)	

WARNING

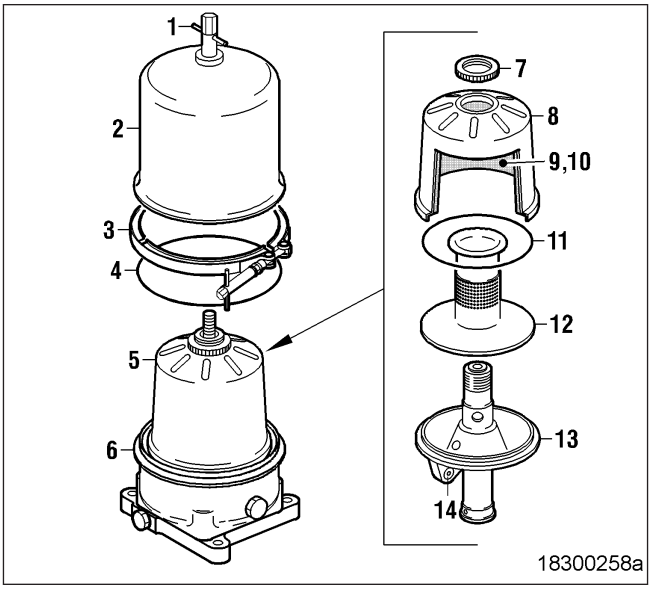
Hot oil.
Oil can contain combustion residues which are harmful to health.
Risk of injury and poisoning!
- Wear protective clothing, gloves, and goggles / safety mask.
- Avoid contact with skin.
- Do not inhale oil vapor.

WARNING

Compressed air
Risk of injury!
- Do not direct compressed-air jet at persons.
- Wear protective goggles / safety mask and ear protectors.

TIM-ID: 0000000958 - 003

Cleaning centrifugal oil filter and replacing filter sleeve



1. Undo screw (1) and remove.
2. Remove clamp (3) and take off hood (2).
3. Carefully remove rotor (5) from housing.
4. Hold rotor assembly (5) firmly in position with filter wrench and undo knurled nut (7).
5. Take off rotor cap (8).
6. Remove filter sleeve (9), stiffener plate (10) and sealing ring (11).
7. Measure thickness of oil residues on filter sleeve.
8. If maximum layer thickness of oil residues exceeds 30 mm, shorten maintenance interval.
9. Remove standpipe (12) from lower rotor section (13).
10. Wash hood (2), rotor cap (8), stiffener plate, (10) standpipe (12), rotor lower section (13) and nozzles (14) with cold cleaner and blow out with compressed air. Do not use sharp objects for cleaning.
11. Check nozzles (14) for obstructions.
12. Press standpipe (12) onto rotor lower section (13).
13. Insert new filter sleeve (9) with stiffener plate (10) into rotor cap (8), ensuring that smooth surface of filter sleeve (9) faces rotor cap (8).
14. Check sealing ring (11), replace if necessary. Coat sealing ring with grease and insert in groove of rotor cap (8).
15. Place rotor cap (8) onto standpipe (12).
16. Hold rotor assembly (5) firmly in position with filter wrench and tighten knurled nut (7).
17. Lubricate bearings of rotor (5) with oil, insert into housing (6) and check for ease of movement.
18. Check sealing ring (4), replace if necessary. Fit sealing ring on housing (6).
19. Fit hood (2).
20. Tighten screw (1) by hand.
21. Install clamp (3) and tighten to specified torque using a torque wrench.

Name	Size	Type	Lubricant	Value/Standard
Clamp		Tightening torque		6 Nm + 1 Nm

22. Tighten screw (1) to specified torque using a torque wrench.

Name	Size	Type	Lubricant	Value/Standard
Screw		Tightening torque		6 Nm + 1 Nm

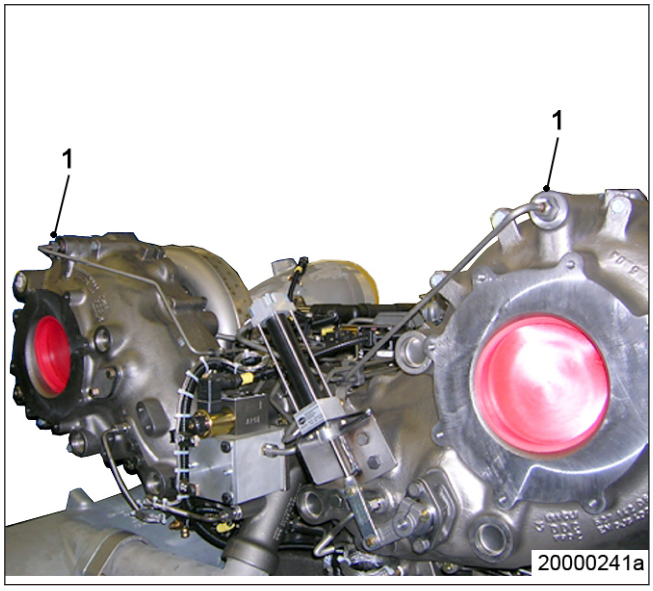
TIM-ID: 0000000958 - 003

7.16 Coolant Circuit, General, High-Temperature Circuit

7.16.1 Venting points

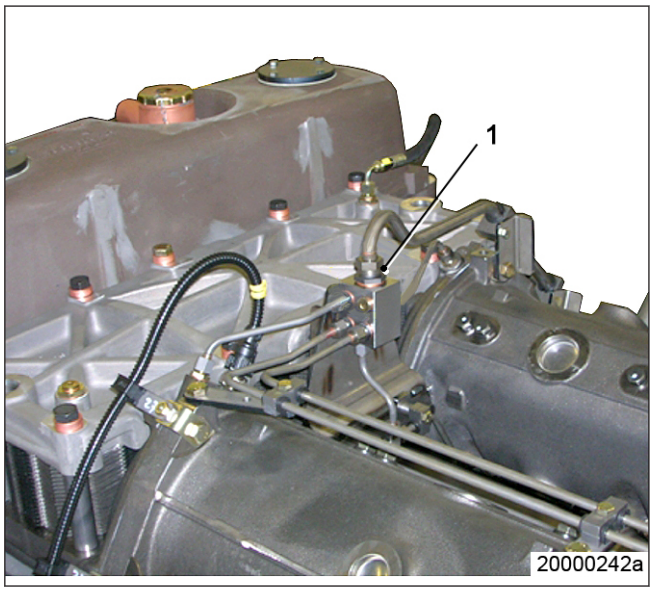
Coolant lines on ETC

1 Venting point



Vent line – Cross-distributionn expansion tank

1 Venting point



TIM-ID: 0000006694 - 002

7.16.2 Engine coolant – Level check

Preconditions

☑ Engine is stopped and starting disabled.

☑ MTU Fluids and Lubricants Specifications (A001061/..) are available.

WARNING

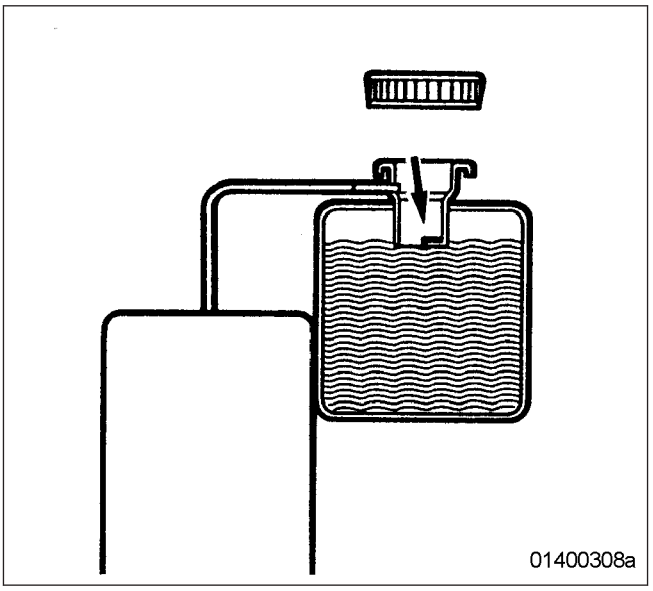
Coolant is hot and under pressure.
Risk of injury and scalding!
- Let the engine cool down.
- Wear protective clothing, gloves, and goggles / safety mask.

Checking engine coolant level at filler neck:

1. Turn breather valve on coolant expansion tank counterclockwise to the first stop and allow pressure to escape.
2. Continue to turn breather valve counterclockwise and remove.
3. Check coolant level (coolant must be visible at the lower edge of the cast-in eye).

Checking engine coolant level at remote cooler:

1. Check coolant level (coolant must be visible at marking plate).
2. Top up coolant if necessary (→ Page 167).
3. Check and clean breather valve.
4. Place breather valve on filler neck and close.



Checking engine coolant level via level sensor:

1. Switch on engine control system and check readings on the display.
2. Top up coolant if necessary (→ Page 167).

TIM-ID: 0000000937 - 011

7.16.3 Engine coolant – Change

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Engine coolant		

Changing engine coolant

1. Drain engine coolant (→ Page 166).
2. Fill with engine coolant (→ Page 167).

TIM-ID: 0000000036 - 028

7.16.4 Engine coolant – Draining

Preconditions

☑ Engine is stopped and starting disabled.

WARNING

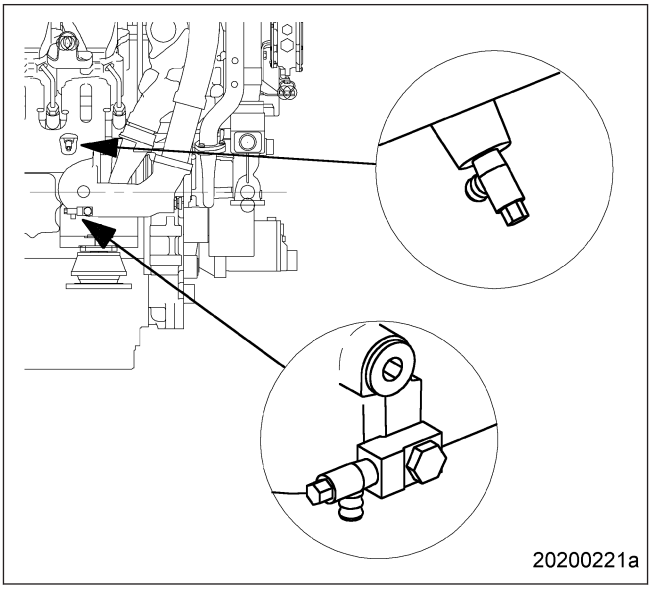
Coolant is hot and under pressure.
Risk of injury and scalding!
- Let the engine cool down.
- Wear protective clothing, gloves, and goggles / safety mask.

Preparatory steps

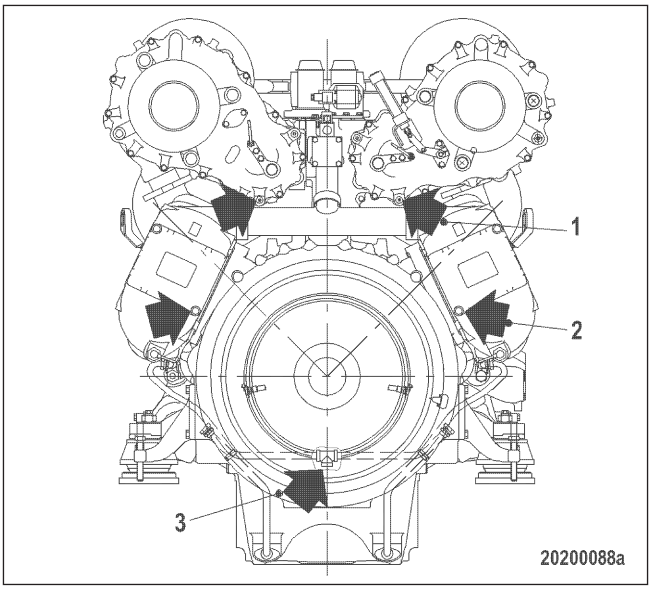
1. Provide an appropriate container to drain the coolant into.
2. Switch off preheating unit.

Engine coolant – Draining

1. Turn breather valve on coolant expansion tank counterclockwise up to the first stop and allow pressure to escape.
2. Continue to turn breather valve counter-clockwise and remove.
3. Draw off separated corrosion inhibitor oil in expansion tank through the filler neck.
4. Open drain valves and/or drain plugs and drain coolant at the following points:
   - At the preheating unit;
   - At the HT coolant pump elbow;
   - At the crankcase, left and right side.



5. Additional drain points on 12/16V 4000 M engines:
   - T-piece (3) on engine driving end;
   - Intercooler (2), left and right side;
   - Carrier-housing cover (1), left and right side.
6. Close all open drain points.
7. Place breather valve on filler neck and close.



TIM-ID: 0000006745 - 002

7.16.5 Engine coolant – Filling

Preconditions

☑ Engine is stopped and starting disabled.

☑ MTU Fluids and Lubricants Specifications (A001061/..) are available.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Engine coolant		

WARNING

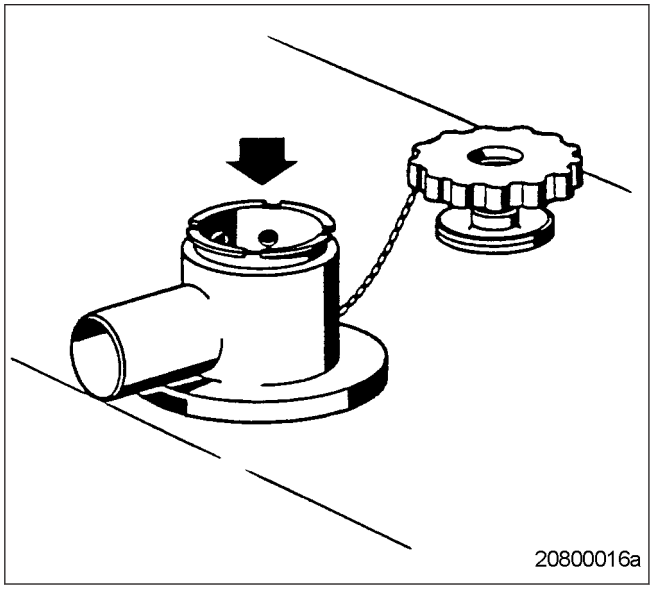
Coolant is hot and under pressure.
Risk of injury and scalding!
- Let the engine cool down.
- Wear protective clothing, gloves, and goggles / safety mask.

CAUTION

Cold coolant in hot engine can cause thermal stress.
Formation of cracks in components!
- Fill / top up coolant only into cold engine.

Preparatory steps

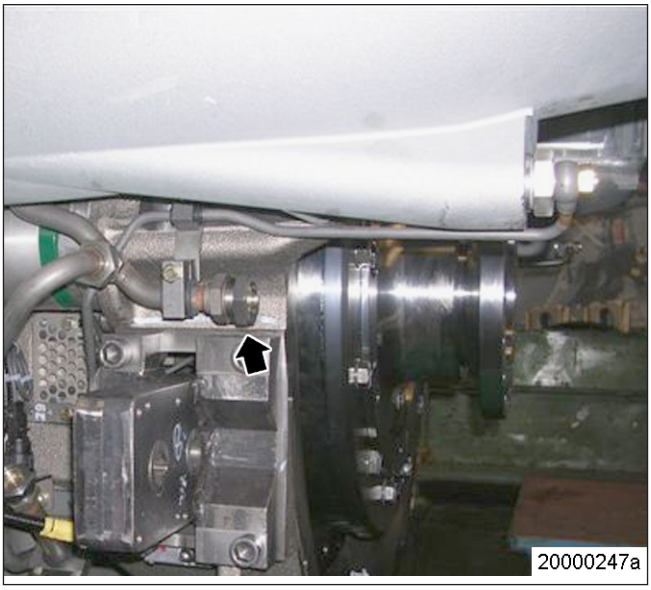
1. Turn breather valve of coolant expansion tank counterclockwise to first stop and allow pressure to escape.
2. Continue to turn breather valve counterclockwise and remove.
3. Release the coolant line union on both turbochargers (→ Page 163).
4. Release the coolant line union at the coolant distributor (→ Page 163).



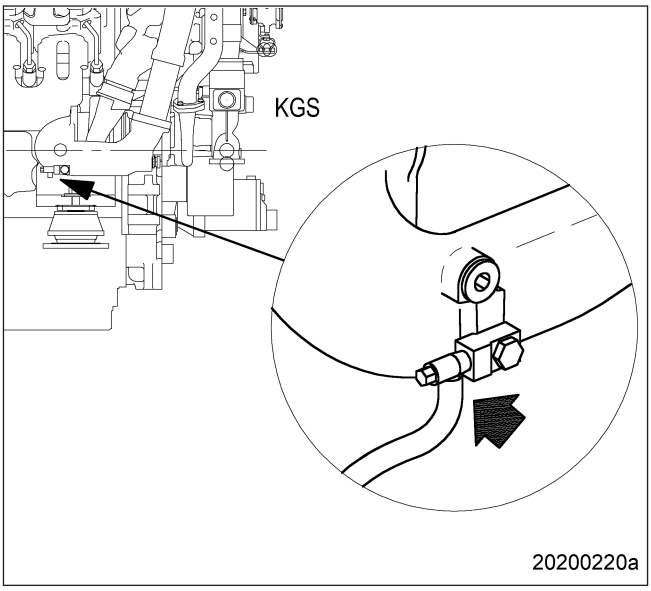
TIM-ID: 0000006727 - 004

Filling with coolant using a pump

1. Connect appropriate pump with hose to filling connection (arrow) on A side or B side. Alternatively:



2. Connect a suitable pump with a hose to drain valve (arrowed).
3. Pump coolant into engine at 0.5 bar minimum until coolant emerges from the loosened unions at the coolant distributor.
4. Tighten the union for coolant line at the coolant distributor (→ Page 163).
5. Fill expansion tank until overflow edge is reached.
6. Check proper condition of breather valve and clean sealing faces if required.
7. Place breather valve on filler neck and close.
8. Continue filling process until coolant emerges from the loosened unions at the two turbochargers.
9. Tighten the coolant line union on both turbochargers (→ Page 163).
10. Start engine (→ Page 93).
11. After the engine has run at idling speed for 10 seconds, stop engine (→ Page 100).
12. Turn breather valve of coolant expansion tank counterclockwise to first stop and allow pressure to escape.
13. Continue to turn breather valve counterclockwise and remove.
14. Check coolant level (→ Page 164) and top up engine coolant as required:
    a) Fill in coolant in expansion tank until the coolant level at top edge of filler neck remains constant.
    b) Place breather valve on filler neck and close.
    c) Repeat the steps from "Start engine" (→ Step 9) until coolant no longer needs to be topped up.
    d) Disconnect pump and hose.



TIM-ID: 0000006727 - 004

Filling with coolant through filler neck

1. Alternatively: Fill coolant through filler neck on expansion tank until coolant emerges from the loosened unions at the coolant distribution.
2. Tighten the union for coolant line at the coolant distributor (→ Page 163).
3. Continue to fill until coolant level remains constant at top edge of filler neck.
4. Tighten the coolant line union on both turbochargers (→ Page 163).
5. Check proper condition of breather valve and clean sealing faces if required.
6. Set breather valve onto filler neck and turn until the first stop to close.
7. Start engine (→ Page 93).
8. After the engine has run at idling speed for 10 seconds, stop engine (→ Page 100).
9. Turn breather valve counterclockwise and remove.
10. Check coolant level (→ Page 164) and top up engine coolant as required:
    a) Repeat the steps from "Start engine" (→ Step 7) until coolant no longer needs to be topped up.
    b) Check proper condition of breather valve and clean sealing faces if required.
    c) Place breather valve on filler neck and close.

TIM-ID: 0000006727 - 004

7.16.6 Engine coolant pump – Relief bore check

DANGER

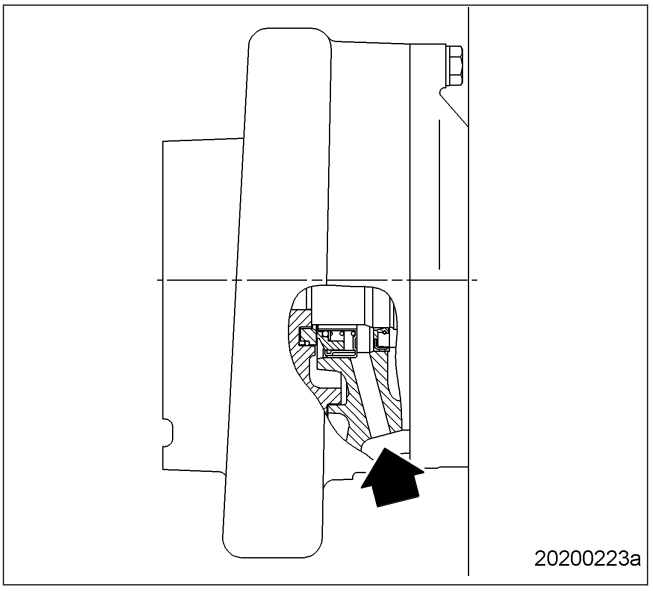
Unguarded rotating and moving engine components.
Risk of serious injury – danger to life!
- Take special care when working on a running engine.

WARNING

Engine noise above 85 dB (A).
Risk of damage to hearing!
- Wear ear protectors.

Engine coolant pump – Relief bore check

1. Check relief bore for oil and coolant discharge.
2. Stop engine (→ Page 100) and disable engine start, observe general safety instructions for maintenance and repair.
3. Clean the relief bore with a wire if it is dirty.
   - Permissible coolant discharge: up to 10 drops per hour.
   - Permissible oil discharge: up to 5 drops per hour.
4. If discharge exceeds the specified limits: Contact Service.



TIM-ID: 0000000961 - 008

7.16.7 Engine coolant – Sample extraction and analysis

Preconditions

☑ MTU Fluids and Lubricants Specifications (A001061/..) are available.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
MTU test kit	5605892099/00	1

DANGER

Unguarded rotating and moving engine components.
Risk of serious injury – danger to life!
- Take special care when working on a running engine.

WARNING

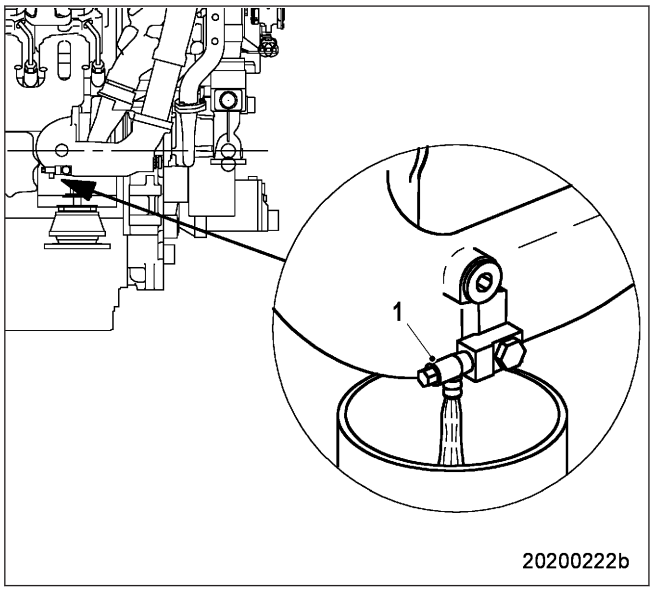
Coolant is hot and under pressure.
Risk of injury and scalding!
- Let the engine cool down.
- Wear protective clothing, gloves, and goggles / safety mask.

WARNING

Engine noise above 85 dB (A).
Risk of damage to hearing!
- Wear ear protectors.

Engine coolant – Sample extraction and analysis

1. With the engine running, open drain valve (1).
2. Flush sample-extraction point by draining approx. 1 liter coolant.
3. Drain approx. 1 liter coolant into a clean container.
4. Close drain valve (1).
5. Using the equipment and chemicals of the MTU test kit, check the coolant for:
   - Antifreeze concentration
   - Corrosion inhibitor concentration
   - pH value.
6. For engine coolant change intervals, refer to (→ MTU Fluids and Lubricants Specifications).



TIM-ID: 0000000938 - 006

7.17 Raw Water Pump with Connections

7.17.1 Raw water pump – Relief bore check

DANGER

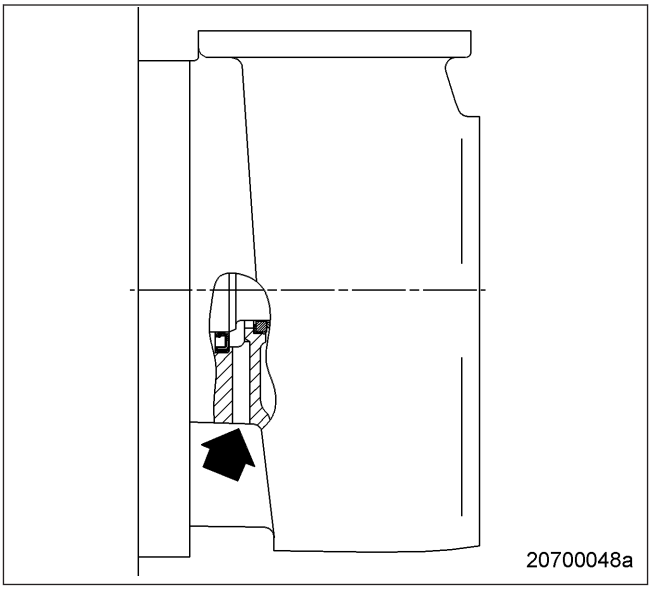
Unguarded rotating and moving engine components.
Risk of serious injury – danger to life!
- Take special care when working on a running engine.

WARNING

Engine noise above 85 dB (A).
Risk of damage to hearing!
- Wear ear protectors.

Checking relief bore on raw water pump

1. Check relief bore for oil and raw water discharge.
2. Stop engine (→ Page 100) and disable engine start, observe general safety instructions for maintenance and repair.
3. Clean the relief bore with a wire if it is dirty.
   - Permissible raw water discharge: up to 10 drops per hour;
   - Permissible oil discharge: up to 5 drops per hour.
4. If discharge exceeds the specified limits: Contact Service.



TIM-ID: 0000007282 - 004

7.18 Battery-Charging Generator

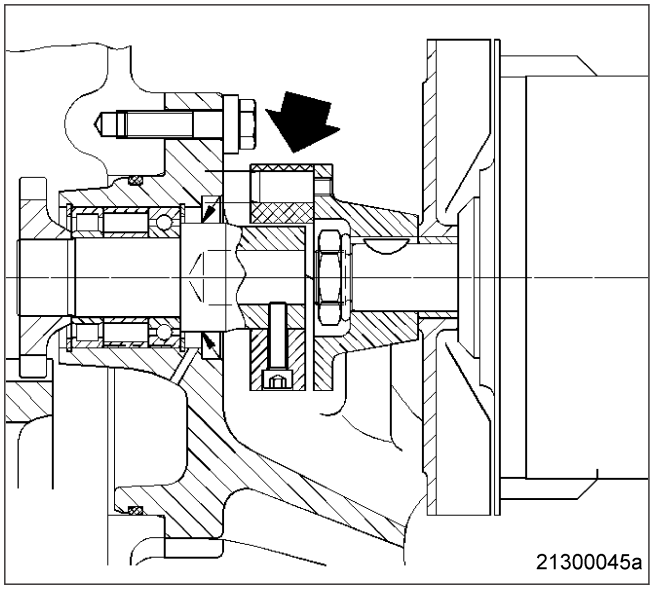
7.18.1 Battery-charging generator drive – Coupling condition check

Preconditions

☑ Engine shut down and starting disabled.

Checking condition of battery-charging generator drive coupling

1. Remove protective cover.
2. Check resilient coupling for cracks and deformation (arrow).
3. Contact Service in case of severe deformation or cracking.
4. Install protective cover.



TIM-ID: 0000007390 - 006

7.19 Engine Mounting / Support

7.19.1 Engine mounts – Checking securing screws for firm seating

Preconditions

☑ Engine is stopped and starting disabled.

Engine mounts – Checking securing screws for firm seating

1. Check securing screws for firm seating.
2. Tighten loose threaded connections.

TIM-ID: 0000007548 - 007

7.19.2 Engine mounts – Resilient element check

Preconditions

☑ Engine is stopped and starting disabled.

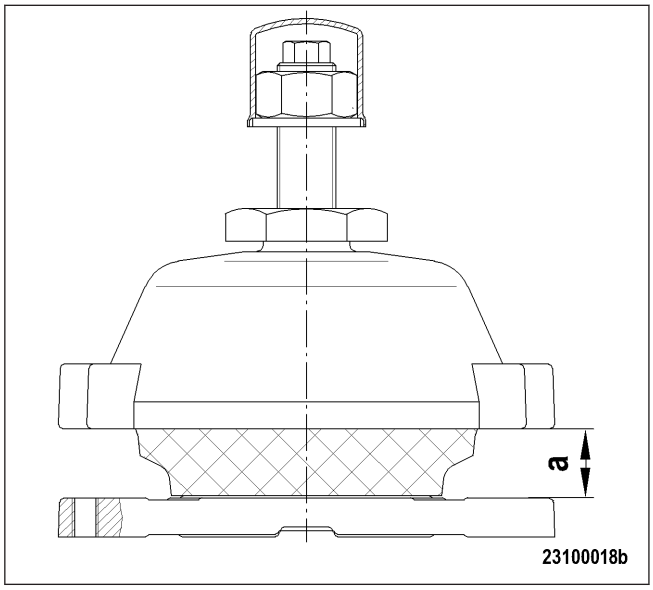
☑ Engine is filled with coolant and engine oil.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Feeler gauge	Y20010128	1
Calipers	Y20001743	1
Box wrench	F30379609	1
Engine oil		

Engine mounts – Checking the condition of resilient elements

1. Wipe rubber surface with dry cloth, do not use organic detergents.
2. Check resilient elements for crack formation and deformation by visual inspection.
3. Have cracked mounts replaced, contact Service.



Engine mounts – Measuring adjustment dimension

1. Measure dimension (a) with Vernier caliper.

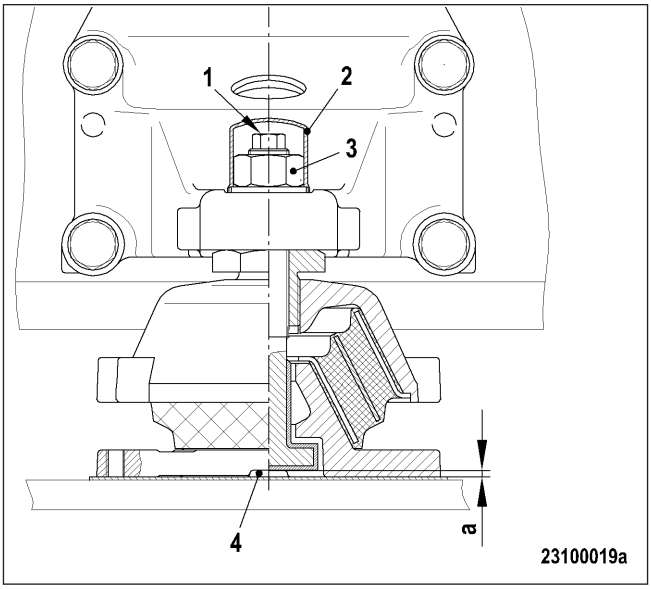
Note: On new blocked mounts, the adjustment dimension is approx. 28 mm.

2. If the measured value of dimension a = 20 mm is lower than the specified value, the resilient element must be replaced, contact Service.

TIM-ID: 0000007556 - 004

Engine mounts – Checking buffer clearance

1. Take off protective cap (2).
2. Check marking (1):
   - With marking 30: a = 3 mm +0,3 mm.
   - With marking 40: a = 4 mm +0,3 mm.
3. Check dimension (a) with feeler gauge on measuring groove (4).
4. If dimension (a) deviates from the above specifications, adjust buffer clearance.



Engine mounts – Buffer clearance adjustment

1. Undo nut (3).
2. Adjust buffer clearance by turning the central buffer (1).
3. Coat mating face of nut (3) and thread of central buffer (1) with a little engine oil. Engine oil must not get in contact with the rubber elements of the resilient mount.
4. Tighten nut (3) to the specified tightening torque securing the central buffer (1) to prevent it turning.

Name	Size	Type	Lubricant	Value/Standard
Nut	M27 x 2	Tightening torque	(Engine oil)	580 Nm +50 Nm

5. Fit protective cap (2).

TIM-ID: 0000007556 - 004

7.20 Drive Systems, Driving End and Free End (Coupling)

7.20.1 Coupling – Condition check

Preconditions

☑ Engine is stopped and starting disabled.

Coupling – Condition check

1. Remove perforated plate(s).
2. Wipe rubber element with dry cloth, do not use organic detergents.
3. Check condition of coupling through assembly hole(s), using a torch. Hair cracks in the rubber elements are permissible.
4. If a considerable number of deeper cracks or places with broken-off rubber are found, contact Service.
5. Install perforated plate(s).

TIM-ID: 0000007655 - 002

7.21 Auxiliary PTO

7.21.1 Bilge pump – Relief bore check

DANGER

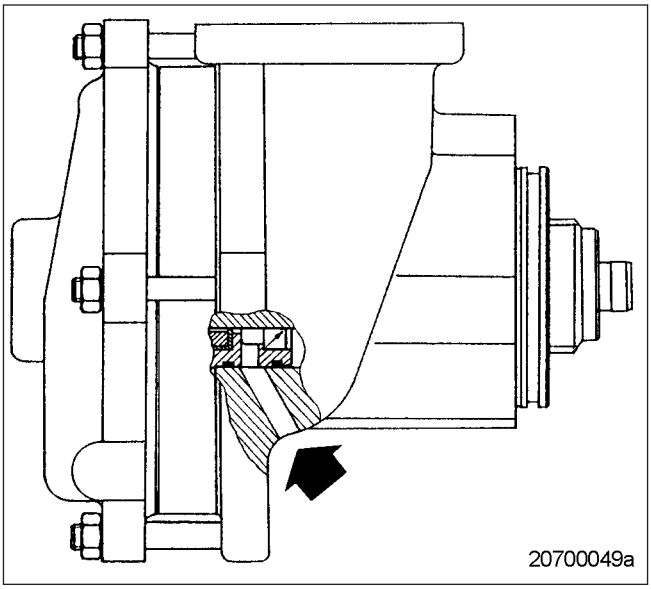
Unguarded rotating and moving engine components.
Risk of serious injury – danger to life!
- Take special care when working on a running engine.

WARNING

Engine noise above 85 dB (A).
Risk of damage to hearing!
- Wear ear protectors.

Bilge pump – Relief bore check

1. Check relief bores for oil and water discharge.
2. Stop engine (→ Page 100) and disable engine start.
3. Clean the relief bores with a wire if dirty.
   - Permissible water discharge: Up to 10 drops per hour.
   - Permissible oil discharge: Up to 5 drops per hour.
4. If discharge exceeds the specified limits: Contact Service.



TIM-ID: 0000007771 - 003

7.22 Fuel Supply System

7.22.1 Water drain valve – Check

Checking water drain valve

1. Open water drain valve.
2. Check water outlet for obstructions.
3. Close water drain valve.

TIM-ID: 0000007733 - 006

7.22.2 Differential pressure gauge – Check

WARNING

Fuels are combustible.
Risk of fire and explosion!
- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

Checking differential pressure gauge

1. Switch on fuel treatment system (→ Page 95).
2. Set the alarm points at the differential pressure gauge to zero.

Result: Alarm is initiated with preset delay.

3. Reset the alarm points at the differential pressure gauge to the specified values.

TIM-ID: 0000007737 - 005

7.22.3 Water level probe (3-in-1 rod electrode) – Check

Preconditions

☑ System is put out of service and emptied.

WARNING

Fuels are combustible.
Risk of fire and explosion!
- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

Water level probe (3-in-1 rod electrode) – Check

1. Disconnect plug from water level probe.
2. Unscrew water level probe.
3. Disconnect plug from water level probe.
4. Immerse water level probe into a tank filled with water until water level reaches the thread.

Result: Water drain valve opens.

5. Leave water level probe in tank.

Result: Alarm must be triggered with the preset delay.

6. Disconnect plug from water level probe.
7. Remove water level probe from tank.
8. Screw in water level probe.
9. Connect plug for water level probe.
10. Put the fuel treatment system into operation.

TIM-ID: 0000007739 - 006

7.22.4 Pump capacity – Check

WARNING

Fuels are combustible.
Risk of fire and explosion!
- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

Checking pump capacity

1. Install suitable pressure gauge at the neck of the intake side of the pump.
2. Check pump pressure.
   a) Switch on fuel treatment system (→ Page 95).

Note: The pressure limiting valve at the pump might respond and open. Audible noise is caused by overflowing fuel and can be disregarded.

   b) Close ball valve at the outlet of the fuel treatment system.
   c) Check pressure at the pressure gauge in the inlet to the fuel treatment system and note it.
3. Check pump pressure with reduced suction.
   a) Reduce suction pressure of pump to -0.8 bar with the shutoff valve at the pump intake side.
   b) Check pressure at the pressure gauge in the inlet to the fuel treatment system and note it.
   c) Open ball valve at inlet and outlet of fuel treatment system.
4. Calculate wear limit.

Example:	
Measured value (normal condition).	3 bar
Measured value (reduced suction condition).	2.6 bar
If the measured value (reduced suction condition) is 10% lower than the measured value (normal condition), the wear limit is reached. Repair pump (contact Service).	

TIM-ID: 0000007740 - 007

7.22.5 Coalescer filter element – Replacement

Preconditions

☑ System is switched off and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Torque wrench, 6-50 Nm	F30027336	1
Ratchet adapter	F30027339	1
Diesel fuel		
Engine oil		
Coalescer filter element	(→ Spare Parts Catalog)	
Gasket	(→ Spare Parts Catalog)	

WARNING

Fuels are combustible.
Risk of fire and explosion!
- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

CAUTION

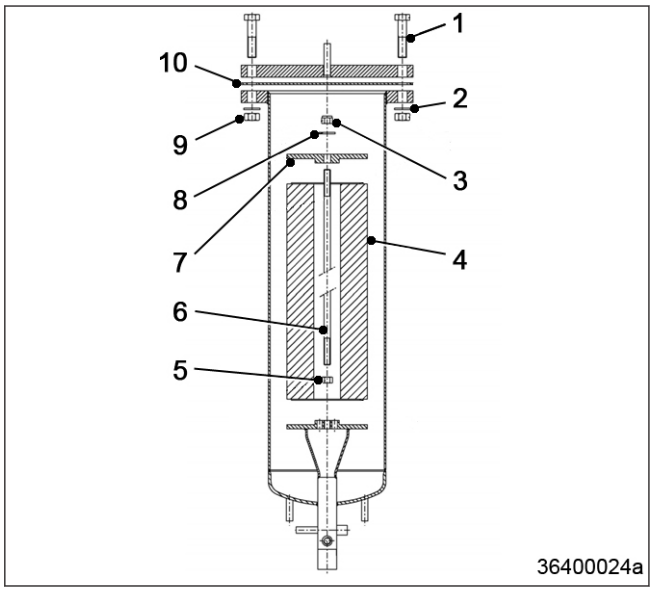
Contamination of components.
Damage to component!
- Observe manufacturer's instructions.
- Check components for special cleanness.

CAUTION

Incorrect installation of components and lines.
Damage to component!
- Ensure that components/lines are installed so that they are never under tension or strain.
- Ensure correct installation position of components.

Replacing coalescer filter element

1. Close ball valve at the inlet and outlet of the fuel treatment system.
2. Open drain valve.
3. Drain fuel.
4. Close drain valve.
5. Remove nut (9) with washer (2).
6. Remove screws (1).
7. Remove cover with gasket (10).
8. Remove nut (3), washer (8) and end plate (7).
9. Remove coalescer filter element (4).
10. Catch fuel as it runs out.
11. Clean housing with a non-linting cloth, rinse with fuel if required.
12. Check housing for corrosion.
13. Clean housing sealing surfaces.
14. Install coalescer filter element.
15. Install end plate (7), washer (8) and nut (3).



TIM-ID: 0000007735 - 006

16. Tighten nut (3) to specified tightening torque using a torque wrench.

Name	Size	Type	Lubricant	Value/Standard
Nut	M16	Tightening torque	(Engine oil)	30 Nm +3 Nm

17. Fit gasket (10).
18. Install cover.
19. Install screw (1), washer (2) and nut (9).
20. Tighten nut (9).
21. Open ball valve at the inlet and outlet of the fuel treatment system.

Result: The fuel treatment system is ready for operation.

TIM-ID: 0000007735 - 006

7.23 Wiring (General) for Engine/Gearbox/Unit

7.23.1 Engine wiring – Check

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Isopropyl alcohol	X00058037	1

Engine wiring – Check

1. Check securing screws of cable clamps on engine and tighten loose threaded connections.
2. Ensure that cables are fixed in their clamps and cannot swing freely.
3. Check that cable ties are firm, tighten loose cable ties.
4. Replace faulty cable ties.
5. Visually inspect the following electrical line components for damage:
   - connector housings;
   - contacts;
   - sockets;
   - cables and terminals;
   - plug-in contacts.
6. (→ Contact Service) if cable conductors are damaged.

Note: Close male connectors that are not plugged in with the protective cap supplied.

7. Clean dirty connector housings, sockets and contacts with isopropyl alcohol.
8. Ensure that all sensor connectors are securely engaged.

TIM-ID: 0000000029 - 018

7.24 Accessories for (Electronic) Engine Governor / Control System

7.24.1 Engine governor and connectors – Cleaning

Preconditions

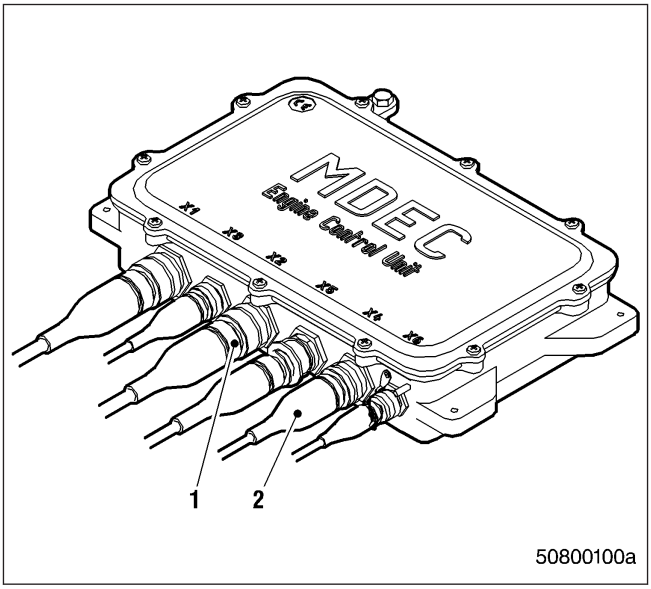
☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Connector pliers	0135315483	1
Isopropyl alcohol	X00058037	1

Cleaning engine governor and connectors

1. Remove heavy soiling from housing surface with isopropyl alcohol.
2. Remove dirt from surface of connectors (1), connector sockets and shrink-formed components (2) using a cloth moistened with isopropyl alcohol.
3. Check legibility of cable labels. Clean or replace illegible labels.



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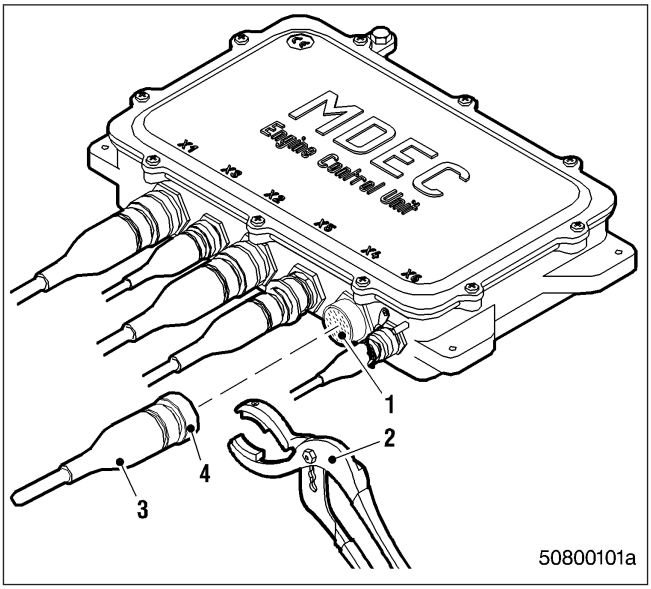
Cleaning heavily soiled connectors on engine governor

1. Use connector pliers (2) to disengage bayonet union nut (4) and withdraw connector (3).
2. Clean connector housings, connector socket housings (1) and all contacts with isopropyl alcohol.
3. When connectors, sockets and all contacts are dry: Fit connectors and check engine governor plug connections (→ Page 189).



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TIM-ID: 0000000948 - 009

7.24.2 Engine monitoring unit and connectors – Cleaning

Preconditions

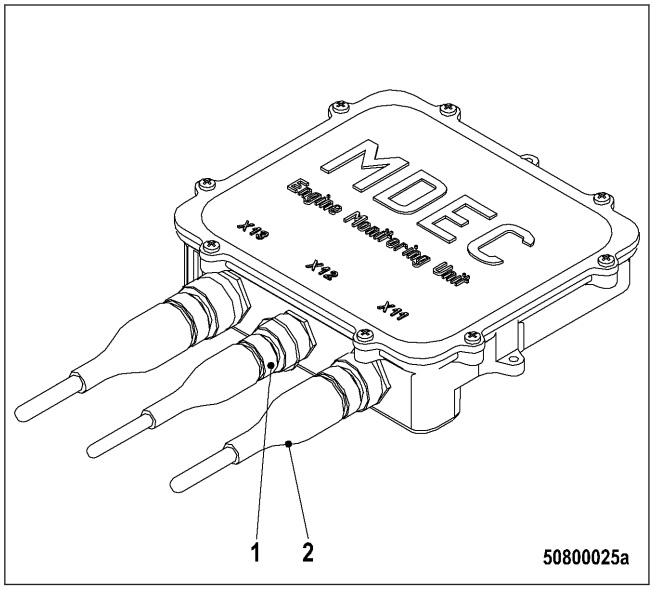
☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Connector pliers	0135315483	1
Isopropyl alcohol	X00058037	1

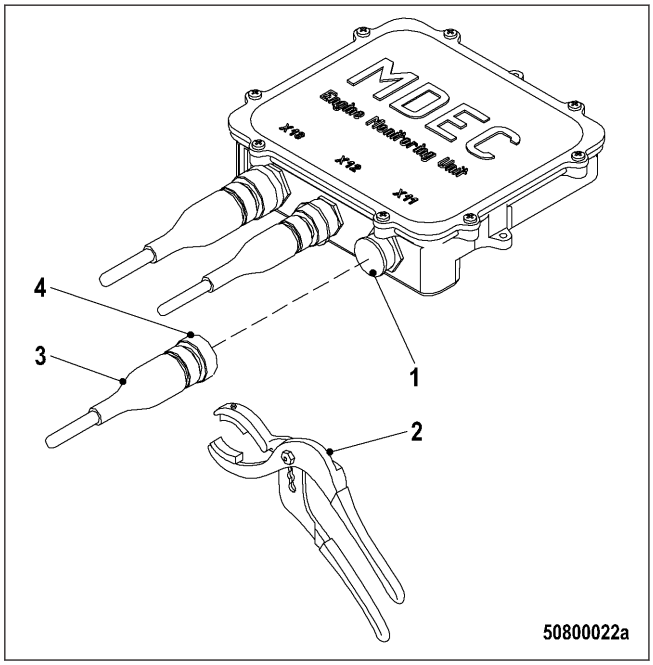
Engine monitoring unit and connectors – Cleaning

1. Remove coarse dirt from housing surface with isopropyl alcohol.
2. Remove dirt from surface of connectors (1), connector sockets and shrink sleeves (2) using a cloth moistened with isopropyl alcohol.
3. Check legibility of cable labels. Clean or replace illegible labels.



Cleaning severely contaminated EMU connectors

1. Use connector pliers (2) to disengage bayonet union nut (4) and withdraw connector (3).
2. Clean connector housings, connector socket housings (1) and all contacts with isopropyl alcohol.
3. When connectors, sockets and all contacts are dry: Fit connectors and check plug connections on EMU (→ Page 190).



TIM-ID: 0000008391 - 005

7.24.3 Limit switch for start interlock – Check

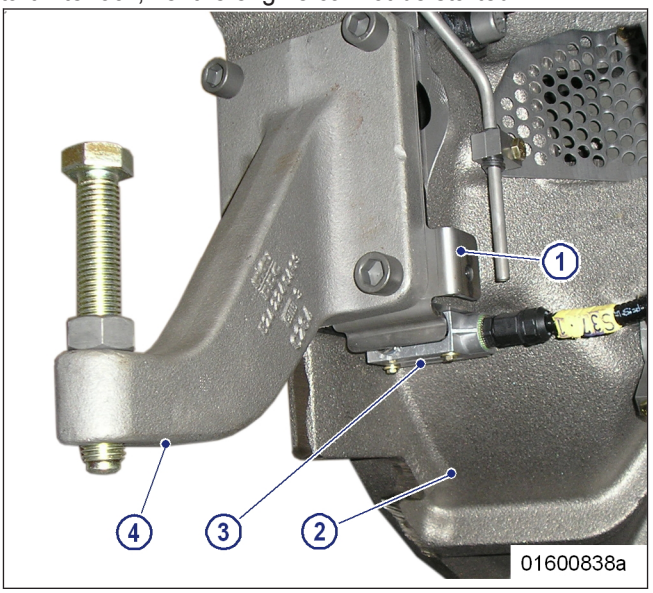
Preconditions

☑ Engine is stopped and starting disabled.

Note: In the OFF position, the limit switch initiates a start interlock, i.e. the engine cannot be started.

Checking limit switch for start interlock

1. Check whether switches (3) and guard plate (1) with engine support (4) are installed on both sides of flywheel housing (2).
2. Check whether both switches (3) are actuated.
3. If switches (3) and/or guard plate (1) with engine support (4) is/are not installed:
   - Screw on guard plate (1) with engine support (4).
   - Then screw on switch (3), ensuring that the switch (3) is actuated by the guard plate (1).
4. If switch (3) and guard plate (1) are installed, but switch (3) is in the OFF position:
   - Make certain that the guard plate (1) at the side of the switch (3) is not distorted.
   - Release guard plate (1) and screw on such that the switch (3) is actuated.



TIM-ID: 0000016782 - 006

7.24.4 Checking engine control unit plug connections

Preconditions

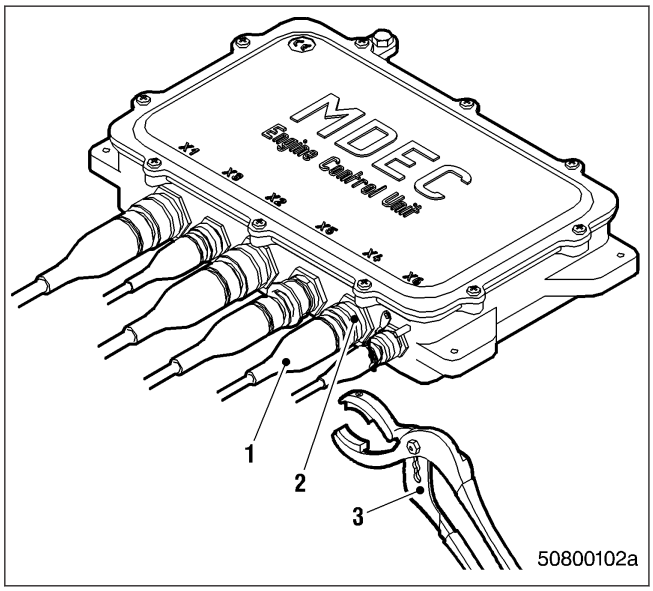
☑ Engine shut down and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Connector pliers	0135315483	1

Checking engine control unit plug connections

1. Use connector pliers (3) to make certain that all plug-in connections on engine control unit are securely seated.
2. Tighten loose bayonet couplings (2) with connector pliers (3) by turning them clockwise until they latch into place.
3. Make sure that unassigned sockets are closed off with cover caps.
4. Contact Service if bayonet union nut is defective.



TIM-ID: 0000000949 - 003

7.24.5 Engine monitoring unit – Plug connection check

Preconditions

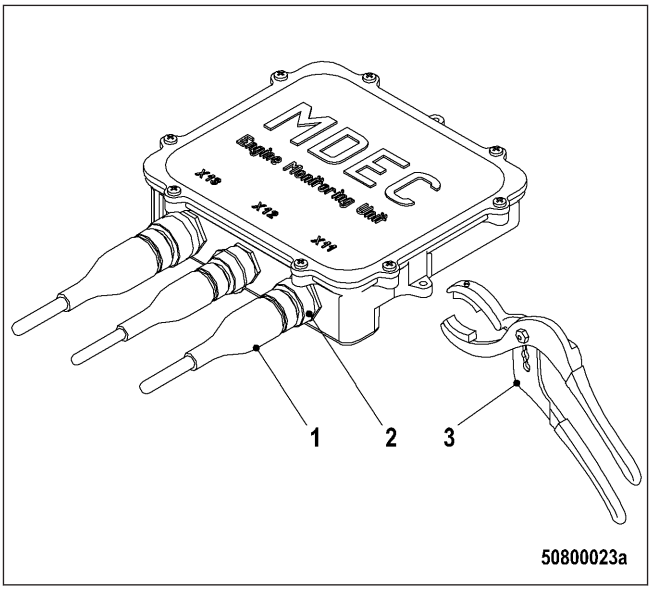
☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Connector pliers	0135315483	1

Checking engine monitoring unit plug connections

1. Use connector pliers (3) to make certain that all engine monitoring unit plug connections are securely seated.
2. Tighten loose bayonet union nuts (2) with connector pliers (3) by turning them clockwise until they lock into place.
3. Make sure that unassigned sockets are closed off with cover caps.
4. If bayonet couplings are defective, contact Service.



TIM-ID: 0000008394 - 003

7.24.6 Engine control unit – Removal and installation

Preconditions

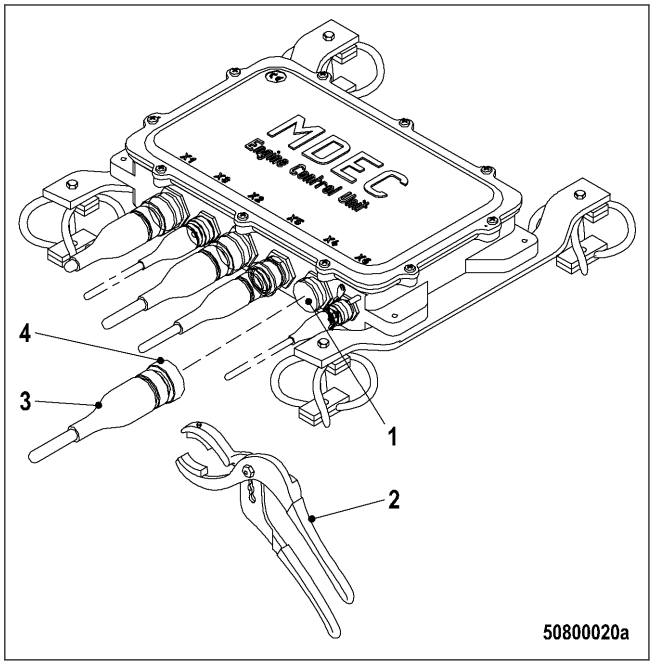
☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Connector pliers	0135315483	1
Covering caps for Cannon sockets		

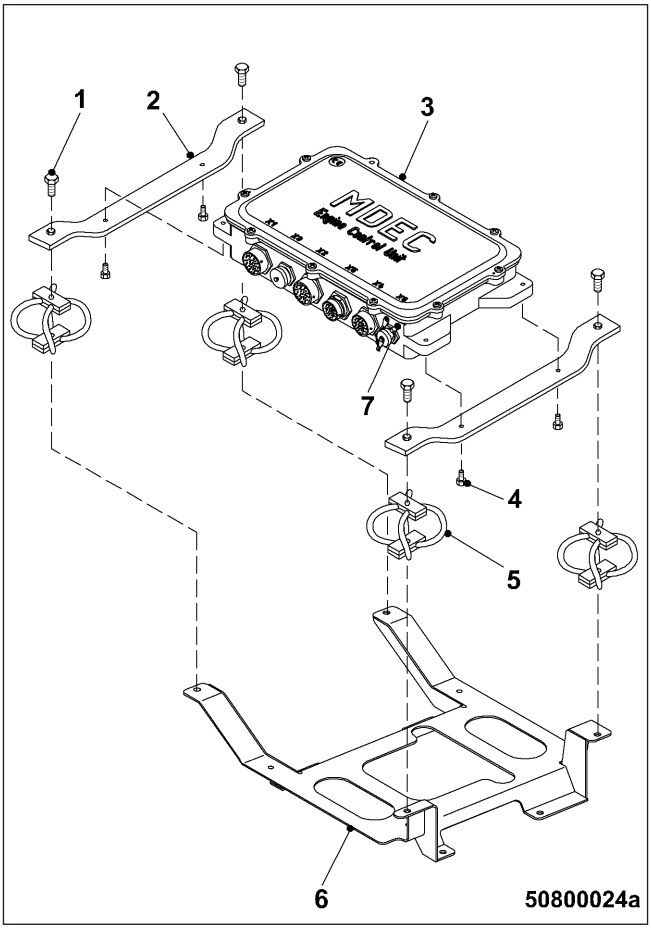
Removing control unit from engine

1. Note or mark assignment of cables to connector sockets.
2. Use connector pliers (2) to disengage the bayonet union nuts (4) of the connectors (3) by turning them counterclockwise.
3. Remove all connectors.
4. Close connector sockets with appropriate covering caps (1).



TIM-ID: 0000008487 - 004

5. Disconnect ground strap from engine control unit grounding stud (7).
6. If the screws (4) are easily accessible:
   1. Remove screws (4).
   2. Remove engine control unit housing (3) from mounting plates (2).
   3. Unscrew mounting plates (2), cable shock absorbers (5) and further fastening parts (6) as one unit from engine.
7. If the screws (4) are not easily accessible:
   1. Unscrew screws (1).
   2. Remove engine control unit housing (3) together with mounting plates (2).
   3. Unscrew cable shock absorbers (5) and further fastening parts (6) as one unit from engine.



Installing engine control unit on engine

1. Install in reverse order. Ensure correct assignment of plugs and sockets.
2. Use connector pliers to turn the bayonet union nuts of the connectors clockwise until they lock into place.

TIM-ID: 0000008487 - 004

7.24.7 LOP – Visual inspection

Preconditions

☑ Engine is stopped and starting disabled.

Preparatory steps

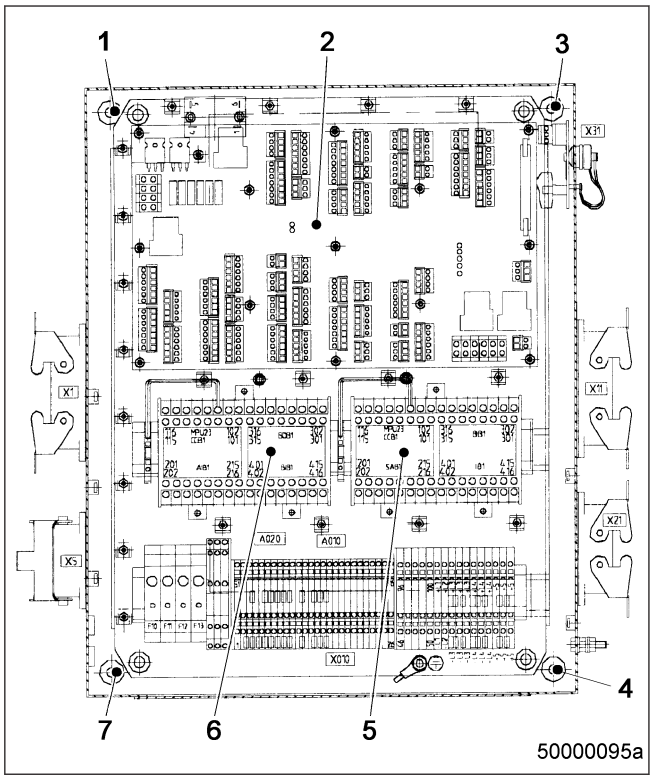
1. If READY FOR OPERATION button is illuminated brightly, press switch briefly.

Result: READY FOR OPERATION button returns to basic brightness.

2. Switch master power switch to OFF.
3. Disconnect battery in accordance with battery manufacturer's instructions.

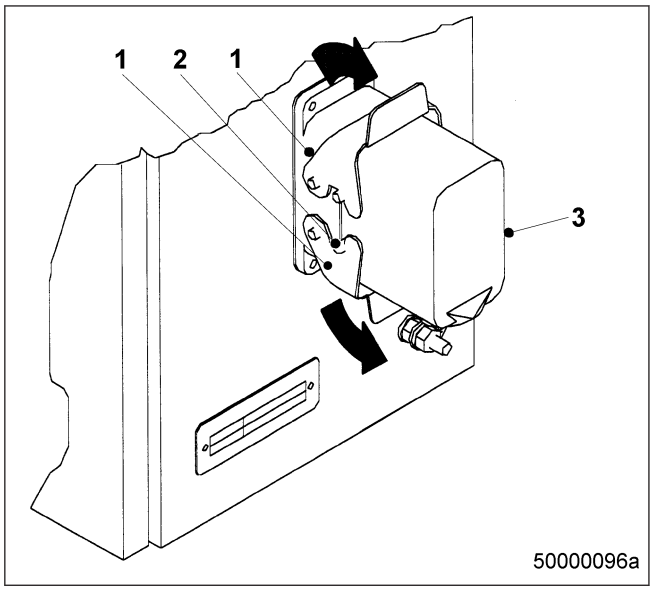
Checking housing and internal assemblies for secure seating

1. Open LOP front door.
2. Check securing screws (1, 3, 4, 7) for firm seating. Tighten loose threaded connections.
3. Check internal assemblies for firm seating, this applies in particular to printed circuit board (2) and PIMs (5, 6). Tighten loose threaded connections.
4. Close LOP front door.



Checking plug connections

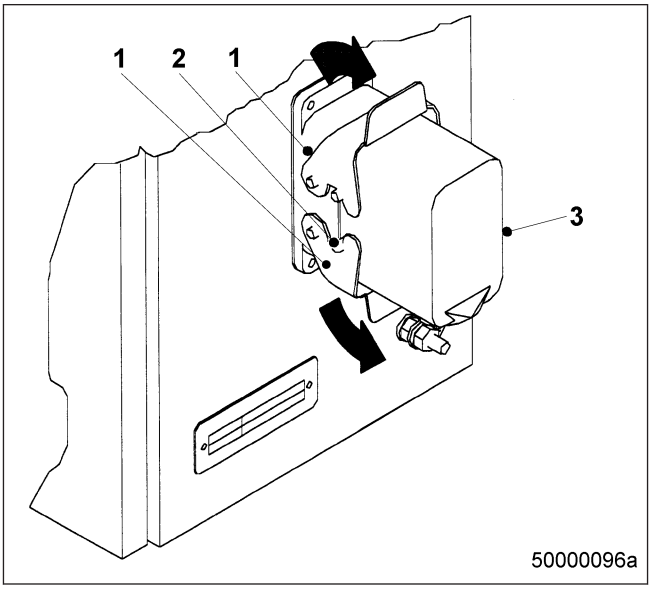
1. Check all connected cables to verify that the two securing elements (1) are engaged on the lugs (2) so that the respective male connector (3) is held firmly in place in the socket.
2. If this is not the case, press the securing elements (1) concerned in the direction of the arrow until they engage noticeably.



TIM-ID: 0000031189 - 002

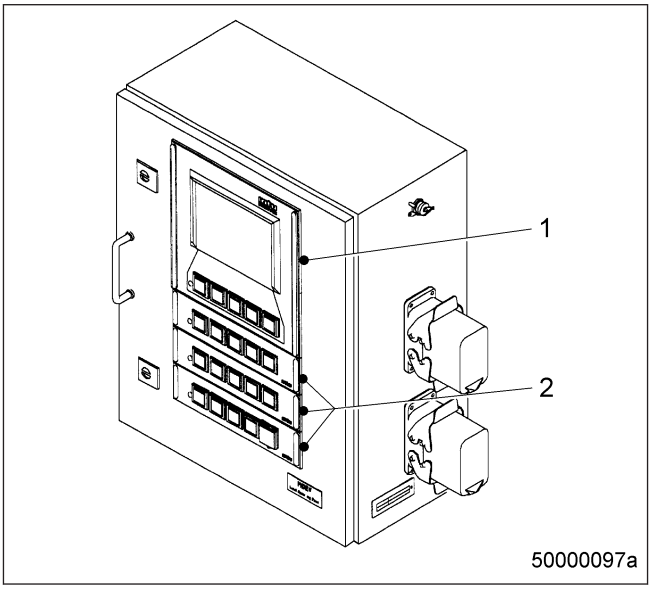
Checking unassigned connector sockets

1. Ensure that non-assigned connector sockets are protected with covering caps.
2. Make certain that the two securing elements (1) are engaged in the lugs (2) so that the covering cap (3) is held firmly in place in the socket.
3. If this is not the case, press the securing elements (1) concerned in the direction of the arrow until they engage noticeably.



Checking buttons and display

1. Buttons: Ensure that
   - Button caps are not damaged (cracks or similar damage)
   - Buttons move easily;
   - Button housings are seated securely;
   - Seals (2) between PAN control panels and LOP housing are not damaged.
2. Display: Ensure that
   - Front glass is not damaged or pressed in;
   - Seal (1) between display housing and LOP housing is not damaged.
3. Have damaged components replaced immediately by Service.

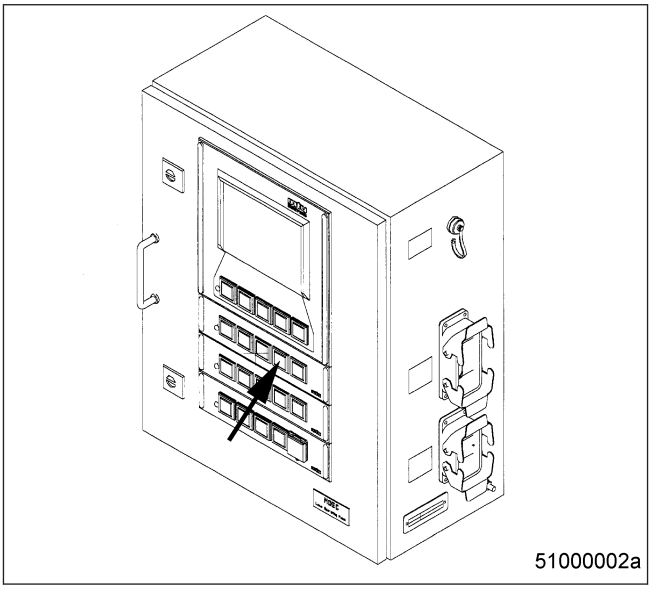


Performing lamp test

1. Connect battery in accordance with battery manufacturer's instructions.
2. Switch master power switch to ON.
3. Switch on Engine Control System.
4. Keep LAMP TEST button pressed:

Result: Indicators and controls light up.

5. Have damaged lamps immediately replaced by Service.



TIM-ID: 0000031189 - 002

8 Appendix A

Abbreviations

Abbreviation	Meaning	Explanation
ADEC	Advanced Diesel Engine Control	Engine governor
AL	Alarm	Alarm (general)
ANSI	American National Standards Institute	Governing body for US American standards
ATL	Abgasturbolader	Exhaust turbocharger
BR	Baureihe	Series
BV	Betriebsstoffvorschrift	Fluids and Lubricants Specifications, MTU Publication No. A01061/..
CAN	Controller Area Network	Data bus system, bus standard
CPP	Controllable Pitch Propeller	
DIN	Deutsches Institut für Normung e. V	German Standardization Organization, at the same time identifyer of German standards ("Deutsche Industrie-Norm")
DIS	Display unit	
DL	Default Lost	Alarm: Default CAN bus failure
ECS	Engine Control System	
ECU	Engine Control Unit	Engine governor
EDM	Engine Data Module	
EIM	Engine Interface Module	Interface to engine monitoring system
EMU	Engine Monitoring Unit	
ETK	Ersatzteilkatalog	Spare Parts Catalog
FPP	Fixed Pitch Propeller	
GCU	Gear Control Unit	
GMU	Gear Monitoring Unit	
HAT	Harbour Acceptance Test	
HI	High	Alarm: Measured value exceeds 1st maximum limit
HIHI	High High	Alarm: Measured value exceeds 2nd maximum limit
HT	High Temperature	
ICFN	ISO - Continuous rating - Fuel stop power - Net	Power specification in accordance with DIN-ISO 3046-7
IDM	Interface Data Module	
IMO	International Maritime Organisation	International maritime organisation
ISO	International Organization for Standardization	
KGS	Kraftgegenseite	Engine free end in accordance with DIN ISO 1204
KS	Kraftseite	Engine driving end in accordance with DIN ISO 1204

Abbrevia-tion	Meaning	Explanation
LCD	Liquid Crystal Display, Liquid Crystal Device	
LCU	Local Control Unit	LOP subassembly
LED	Light Emitting Diode	
LMU	Local Monitoring Unit	LOP subassembly
LO	Low	Alarm: Measured value lower than 1st minimum limit
LOLO	Low Low	Alarm: Measured value lower than 2nd minimum limit
LOP	Local Operating Panel	
LOS	Local Operating Station	
MCS	Monitoring and Control System	
MG	Message	Message
MPU	Microprocessor Unit, Microprocessing Unit	
OT	Oberer Totpunkt	Top dead center
P-xyz	Pressure-xyz	Pressure measuring point xyz
PAN	Panel	Operating panel
PCU	Propeller Control Unit	
PIM	Peripheral Interface Module	
RCS	Remote Control System	
RL	Redundancy Lost	Alarm: Redundant CAN bus failure
SAE	Society of Automotive Engineers	U.S. standardization organization
SAT	Sea Acceptance Test	
SD	Sensor Defect	Alarm: Sensor failure
SDAF	Shut Down Air Flaps	
SS	Safety System	Indicated alarm is initiated by the safety system
SSK	Schnellschlussklappe(n)	Shut-down air flap(s)
T-xyz	Temperature-xyz	Temperature measuring point xyz
TD	Transmitter Deviation	Alarm: Sensor comparison fault
UT	Unterer Totpunkt	Bottom dead center
VS	Voith Schneider	Voith-Schneider drive
WJ	Water Jet	
WZK	Werkzeugkatalog	Tools Catalog
ZKP	Zugehörigkeit-Kategorie-Parameter	Numbering plan for ADEC ECU signals

MTU contacts/service partners

Service

Our worldwide sales network with its subsidiaries, sales offices, representatives and customer service centers ensures fast and direct support on site and the high availability of our products.

Local support

Experienced and qualified specialists place their knowledge and expertise at your disposal.

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With our 24h hotline and the outstanding flexibility of our service staff, we are always ready to assist you - either during operation, for preventive maintenance, corrective work in case of malfunction or changed operating conditions, or for spare parts supply.

Your contact at Headquarters:Service-support@mtu-online.com

Spare parts service

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Your contact at Headquarters:

E-mail: spare.parts@mtu-online.com

Phone: +49 7541 908555

Fax: +49 7541 908121

9 Appendix B

9.1 Special Tools

Barring device	
Part No.:	F6555766
Qty.: Used in:	1 7.1.1 Engine – Barring manually (→ Page 112)

Box wrench	
Part No.:	F30379609
Qty.: Used in:	1 7.19.2 Engine mounts – Resilient element check (→ Page 175)

Calipers	
Part No.:	Y20001743
Qty.: Used in:	1 7.19.2 Engine mounts – Resilient element check (→ Page 175)

Connector pliers	
Part No.:	0135315483
Qty.: Used in:	1 7.24.1 Engine governor and connectors – Cleaning (→ Page 186)
Qty.: Used in:	1 7.24.2 Engine monitoring unit and connectors – Cleaning (→ Page 187)
Qty.: Used in:	1 7.24.4 Checking engine control unit plug connections (→ Page 189)
Qty.: Used in:	1 7.24.5 Engine monitoring unit – Plug connection check (→ Page 190)
Qty.: Used in:	1 7.24.6 Engine control unit – Removal and installation (→ Page 191)

Feeler gauge	
Part No.:	Y20010128
Qty.: Used in:	1 7.4.2 Valve clearance – Check and adjustment (→ Page 122)
Qty.: Used in:	1 7.19.2 Engine mounts – Resilient element check (→ Page 175)

Filling device	
Part No.:	B80144852
Qty.: Used in:	1 7.7.1 Fuel system – Venting and filling (→ Page 135)

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Filter wrench	
Part No.:	F30379104
Qty.: Used in:	1 7.15.2 Centrifugal oil filter – Cleaning and filter sleeve replacement (→ Page 161)

Installation and removal device for injector	
Part No.:	F6790161
Qty.: Used in:	1 7.6.2 Injector – Removal and installation (→ Page 130)

Milling cutter	
Part No.:	F30452739
Qty.: Used in:	1 7.6.2 Injector – Removal and installation (→ Page 130)

MTU test kit	
Part No.:	5605892099/00
Qty.: Used in:	1 7.14.3 Engine oil – Sample extraction and analysis (→ Page 158)
Qty.: Used in:	1 7.16.7 Engine coolant – Sample extraction and analysis (→ Page 171)

Oil filter wrench	
Part No.:	F30379104
Qty.: Used in:	1 7.8.1 Fuel filter – Replacement (→ Page 137)
Qty.: Used in:	1 7.15.1 Engine oil filter – Replacement (→ Page 159)

Ratchet adapter	
Part No.:	F30027340
Qty.: Used in:	1 7.3.2 Crankcase breather – Oil separator replacement, diaphragm check and replacement (→ Page 119)

Ratchet adapter	
Part No.:	F30027341
Qty.: Used in:	1 7.14.2 Engine oil – Change (→ Page 156)

Ratchet adapter	
Part No.:	F30027339
Qty.: Used in:	1 7.15.2 Centrifugal oil filter – Cleaning and filter sleeve replacement (→ Page 161)
Qty.: Used in:	1 7.22.5 Coalescer filter element – Replacement (→ Page 183)

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Ratchet head with extension	
Part No.:	F30006212
Qty.: Used in:	1 7.1.1 Engine – Barring manually (→ Page 112)

Rigid endoscope	
Part No.:	Y20097353
Qty.: Used in:	1 7.2.1 Cylinder liner – Endoscopic examination (→ Page 114)

Ring socket wrench	
Part No.:	F30039518
Qty.: Used in:	1 7.4.2 Valve clearance – Check and adjustment (→ Page 122)

Slotted nut screwdriver	
Part No.:	F30452578
Qty.: Used in:	1 7.6.2 Injector – Removal and installation (→ Page 130)

Steam jet cleaner	
Part No.:	-
Qty.: Used in:	1 4.20 Plant – Cleaning (→ Page 106)

Torque wrench 10-60 Nm	
Part No.:	F30510423
Qty.: Used in:	1 7.4.2 Valve clearance – Check and adjustment (→ Page 122)

Torque wrench 60-320 Nm	
Part No.:	F30047446
Qty.: Used in:	1 7.4.2 Valve clearance – Check and adjustment (→ Page 122)

Torque wrench, 0.5-5 Nm	
Part No.:	0015384230
Qty.: Used in:	1 7.6.2 Injector – Removal and installation (→ Page 130)

Torque wrench, 10-60 Nm	
Part No.:	F30510423
Qty.: Used in:	1 7.6.2 Injector – Removal and installation (→ Page 130)

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Torque wrench, 40-200 Nm	
Part No.:	F30027337
Qty.: Used in:	1 7.14.2 Engine oil – Change (→ Page 156)

Torque wrench, 6-50 Nm	
Part No.:	F30027336
Qty.: Used in:	1 7.22.5 Coalescer filter element – Replacement (→ Page 183)

Torque wrench, 6-50 Nm	
Part No.:	F30027336
Qty.: Used in:	1 7.3.2 Crankcase breather – Oil separator replacement, diaphragm check and replacement (→ Page 119)
Qty.: Used in:	1 7.15.2 Centrifugal oil filter – Cleaning and filter sleeve replacement (→ Page 161)

Torque wrench, 60-320 Nm	
Part No.:	F30047446
Qty.: Used in:	1 7.6.2 Injector – Removal and installation (→ Page 130)

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